The University of Jordan
Authorization Form

I, Nour Kayed Al-Farah authorize the University of Jordan to supply copies of my Thesis/Dissertation to libraries or establishments or individuals on request.

Signature: نور الفرح
Date: 28. 8. 11

Knowledge and practices of Infective Endocarditis prophylaxis among Jordanian dentists.

By
Nour Kayed Alfarah

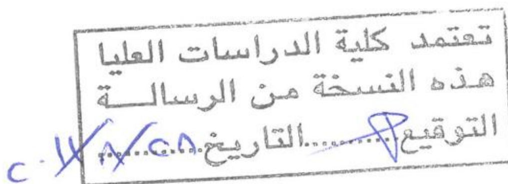
Supervisor
Dr. Mahmoud Al-Omiri

Co-Supervisor
Dr. Lamis Darwish Rajab, Prof

This Thesis was submitted in Partial Fulfillment of the Requirements for the Master's Degree of Science in Pediatric Dentistry

Faculty of Graduate Studies
The University of Jordan

August, 2011



COMMITTEE DECISION

This Thesis (Knowledge and practices of Infective Endocarditis prophylaxis among Jordanian dentists) was successfully defended and approved on July, 10, 2011.

Examination Committee	**Signature**
Dr. Mahmoud K. Al-Omiri, (Supervisor) Assoc. Prof. of Fixed and Removable Prosthodontics & Implants.	------------------------
Prof. Lamis D. Rajab, (Co-supervisor) Prof. of Pediatric Dentistry.	------------------------
Dr. Suhad Al-Jundi, (Member) Assoc. Prof. of Pediatric Dentistry. (Jordan University for Science and Technology)	------------------------
Prof. Mahmoud Hamdan, (Member) Prof. of Pediatric Dentistry.	------------------------
Dr. Zaid Baqain, (Member) Assoc. Prof. of Oral & Maxillofacial Surgery.	------------------------

AKNOWLEDGEMENT

First and foremost, I offer my sincerest gratitude to my supervisor, Dr. Mahmoud Al-Omiri, who has supported me throughout my thesis with his patience and knowledge. His untiring effort, commitment, guidance and support helped me greatly in the understanding and writing of this thesis.

My heartfelt gratitude goes out to my Co-supervisor, Prof. Lamis Rajab. I attribute the level of my Masters degree to her continuous encouragement, and relentless efforts. Without her, this programme and the idea of this research wouldn't have existed.

I'm deeply thankful for Dr. Yousef Khader for his great assistance in statistical analysis. I would also like to thank Prof. Wala Amin, Dr. Zaid Baqain, and Dr. Raed Aqel for their help in constructing the questionnaire.

LIST OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS OR SYMBOLS

IE	Infective Endocarditis
AHA	American Heart Association
BSAC	British Society for Antimicrobial Chemotherapy
BCS	British Cardiac Society
ESC	The European Society of Cardiology
CHD	Congenital heart disease
NICE	The National Institute for Health and Clinical Excellence
RCP	The Royal College of Physicians
UK	The United Kingdom
g	Grams
hr	Hour
IV	Intravenous
IM	Intramuscular
min	Minutes
mg	Milligram
ENT	Ears, nose and throat
GDPs	General dental practitioners
MOH	Ministry of health
RMS	Royal medical services

LIST OF APPENDICES

Knowledge and practices of Infective Endocarditis prophylaxis among Jordanian dentists.

By
Nour Kayed Alfarah

Supervisor
Dr. Mahmoud K. Al-Omiri

Co-Supervisor
Dr. Lamis D. Rajab

ABSTRACT

This cross-sectional study aimed to evaluate the knowledge and practices of Jordanian dentists related to antibiotic prophylaxis for infective endocarditis.

The study used a 4-part questionnaire distributed to a random sample of 300 Jordanian dentists, covering demographic data, medical conditions requiring antibiotic prophylaxis for invasive dental procedures, dental procedures warranting antibiotic prophylaxis in a susceptible patient, mechanisms by which the dentist remains informed of current prophylactic practices and prophylactic antibiotic regimen used.

The mean scores for correct answers for dental procedures and cardiac conditions requiring IE prophylaxis were 72.1 and 57.1 respectively. Most participants prescribed amoxicillin (74%), referred cardiac patients to their treating physician (79.9%), and their previous academic knowledge was the main source of their IE prophylaxis information (74%). More than half followed AHA guidelines, Mitral valve prolapse was the least correctly answered cardiac question and rubber dam placement was the least correctly answered dental procedure.

The overall knowledge of dentists in this study was inadequate, and a pattern of over-prescribing of antibiotics for IE prophylaxis was found. We recommend revisions of the syllabus of related courses at Jordanian universities to cover the subject of IE antibiotic prophylaxis more thoroughly, additional educational means and continuing education programs are also required to keep dentists in Jordan updated regarding recent antibiotic prophylaxis protocols and regimens.

INTRODUCTION

In an era of growing concern over the use and misuse of antibiotics, more focus is placed on the specifics of antibiotic prophylaxis. Although prevention of infection is important, it must be balanced against the expanding problem of antibiotic resistance and side effects of excessive antibiotic use. Guidelines are frequently updated and recommendations are constantly made, yet these are ineffective if practitioners are not keeping abreast of them.

Although IE is a life threatening condition, it is not a direct result of dental visits (Epstein, 1999), and bacteremia resulting from daily activities is much more likely to cause IE than bacteremia associated with a dental procedure. Thus, the usefulness of antibiotic prophylaxis in this setting has been questioned (NICE, 2008, Tsolka and Katritsis, 2009, Wilson, et al., 2007).

A lack of knowledge among health care professionals of the possible incidence of antibiotic adverse reactions, development of multi-resistant bacterial strains, and unnecessary administration of prophylaxis against IE can have serious repercussions. All of these areas are real challenges to the dental profession, in an overall global community health sense as well as a highly individualized clinical or medico-legal sense.

1.1 Significance of the study

IE is an uncommon but life-threatening infection. Despite advances in diagnosis, antimicrobial therapy, surgical techniques, and management of complications, patients with IE still have high morbidity and mortality rates related to this condition (Wilson et al, 2007). The in-hospital mortality rate is about 20% while the 5- year mortality rate is approximately 40% (Delahaye et al, 2009). In addition, more than 50% of patients have to be operated on during the initial phase (Delahaye et al, 2009).

Because IE is a serious condition, knowledge and compliance with proper antibiotic prophylaxis prescription among health care providers are essential. Moreover, inadequate knowledge can cause overuse of antibiotics, with the attendant risks of toxicity and emergence of resistant bacterial strains. Therefore, efforts to improve knowledge and awareness of IE prophylaxis should be emphasized.

This study is the first one that explores IE prophylaxis knowledge and practices among dentists in Jordan. The results are expected to highlight areas of deficient knowledge and prescribing practices among Jordanian dental practitioners, which will help imposing recommendations of better means of educating Jordanian dental practitioners, and significantly reducing the unjustified prescriptions of antibiotics. This will in turn improve practices, lighten the burden of the government's expenses and reduce the adverse effects of antibiotic use.

1.2 Aims and objectives

- To evaluate the level of knowledge of Jordanian dental practitioners of cardiac conditions at risk of acquiring IE.
- To evaluate the level of knowledge of Jordanian dental practitioners of dental procedures likely to cause IE.
- To evaluate the awareness of dental conditions (oral hygiene and periodontal health) as predisposing factors for IE.
- To evaluate dentists' knowledge of the latest recommendations of endocarditis prophylaxis and its implementation in their practice.
- To examine differences in antibiotic prescribing practices among Jordanian dentists in relation to gender, age, specialty, place of practice, and academic job involvement.

LITERATURE REVIEW

2.1 Infective Endocarditis

2.1.1 Definition

Infective endocarditis denotes infection of the endocardial surface of the heart and implies the physical presence of microorganisms in the lesion (Chopra and Kaatz, 2010). Although the heart valves are affected most commonly, the disease can also occur within septal defects or on the mural endocardium. The characteristic lesion, vegetation, is composed of a collection of platelets, fibrin, microorganisms, and inflammatory cells (Chopra and Kaatz, 2010).

2.1.2 Prevalence

An estimated 10,000 – 15,000 new cases of IE are diagnosed in the US each year (Baddour, et al., 2005). The annual incidence is fewer than 10 per 100,000 cases in normal population. (NICE, 2008). However, the incidence varies according to different centers and wide-ranging incidence of predisposing conditions such as prosthetic valves, intravenous drug use, and rheumatic heart disease.

2.1.3 Pathogenesis

Infective Endocarditis is the net result of complex interaction between bloodstream pathogens with matrix molecules and platelets where endocardial cell damage has occurred. Many of the clinical manifestations of IE also develop from the host's immune response to the infecting microorganism (Wilson, et al., 2007) (Figure 1).

In a prospective cohort study by The International Collaboration on Endocarditis, gram-positive organisms were identified as being the most common causative agents (81.5%) for IE with Staphylococcus aureus accounting for 31.2% of all infections (Murdoch, et

al., 2009). Staphylococcus aureus was also the most common organism in each major risk group, including intravenous drug users and those with intracardiac devices (Murdoch, et al., 2009).

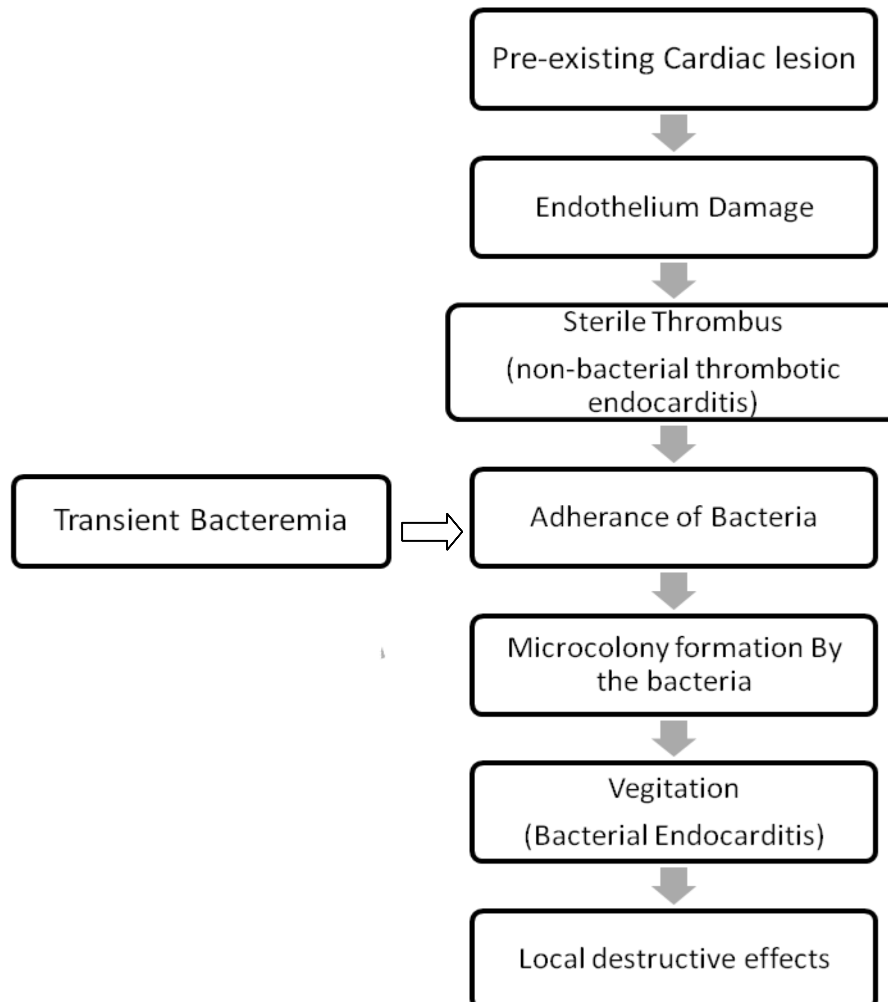


Figure 1: Pathogenesis of IE (as suggested by Carmona, et al., 2007)

2.1.4 Diagnosis

The diagnosis of IE is achieved by a combination of clinical and microbiological features including a careful history and physical examination, blood culture and laboratory results, electrocardiogram, chest radiograph, and echocardiogram (Chopra and Kaatz, 2010).

2.1.5 Treatment

Treatment of IE depends on factors such as the causative organism, cardiac location, clinical manifestations and duration of symptoms, and ensuing complications. The optimal treatment of IE requires a multidisciplinary approach involving medical, surgical, and infectious disease specialists to effectively combat this complex disease (Chopra and Kaatz, 2010). Despite advances in diagnosis and treatment, IE remains a life-threatening disease with significant mortality (approximately 20%) and morbidity (NICE, 2008).

2.2 The Role of the oral cavity in infective endocarditis

2.2.1 Bacteremia from the oral cavity

The human oral cavity is colonized by more than 700 species of bacteria, including aerobic and anaerobic Gram-positive and Gram-negative microorganisms, particularly on the teeth and in the gingival crevices (Paster, et al., 2001). In that rich environment the area of particular relevance to IE is the gingival sulcus where in the healthy state a thin layer of mucosal cells separates these microorganisms from general circulation. However, gingival or periodontal disease may provide the opportunity for these organisms to thrive and gain entrance into ulcerated or manipulated richly vascularized tissues.

In the majority of retrospective studies published during the 1990s, the oral cavity was identified as the portal of entry of causative microbial agents in 14-20% of patients with bacterial endocarditis (Carmona, et al., 2007).

Transient bacteremia is not uncommon with teeth and periodontal tissues manipulation, and a wide variation in reported frequencies of bacteremia exists in patients after certain dental procedures including: tooth extraction (10% to 100%), periodontal

surgery (36% to 88%), scaling and root planing (8% to 80%), teeth cleaning (up to 40%), rubber dam or matrix/wedge placement (9% to 32%), and endodontic procedures (up to 20%) (Wilson, et al., 2007).

In addition, transient bacteremia can result from routine daily activities including tooth brushing and flossing (20% to 68%), use of wooden toothpicks (20% to 40%), use of water irrigation devices (7% to 50%), and chewing food (7% to 51%) (Wilson, et al., 2007).

Taking into acount the number of annual dental visits and the number of times a person gets to perform daily non-dental activities, the frequency of bacteremia associated with routine daily activities might be even greater (Table 1).

Table 1. Incidence of bacteremia in certain dental and non-dental procedures as stated by Wilson, et al. (2007)

Procedure	Incidence of bacteremia
Dental procedures	
Tooth extraction	10% to 100%
Periodontal surgery	36% to 88%
Scaling and root planning	8% to 80%
Teeth cleaning	up to 40%
Rubber dam matrix/wedge placement	9% to 32%
Endodontic procedures	up to 20%
Non-dental	
Tooth brushing and flossing	20% to 68%
Wooden toothpicks	20% to 40%
Water irrigation	7% to 50%
Chewing food	7% to 51%

More than 100 oral bacterial species are recovered from blood cultures after dental procedures, the most prevalent species are viridans group of streptococci, one of the most common microbiological causes of community-acquired native valve IE in non–intravenous drug users (Fowler, et al., 2005, as cited in Wilson, et al., 2007, Murdoch, et al., 2009).

Furthermore, there are no published data that demonstrate that a greater magnitude of bacteremia, compared with a lower magnitude, is more likely to cause IE in humans. Few published studies exist on the magnitude of bacteremia after a dental procedure or routine daily activities, and most of the published data used older, often unreliable microbiological methodology (Wilson, et al., 2007).

2.2.2 Oral Hygiene

A controversial relationship is assumed to exist between poor oral hygiene, extent of dental and periodontal disease, type of dental procedure, and frequency, nature, magnitude, and duration of bacteremia (Lockhart, 1996, Wilson, et al., 2007). On the other hand, available evidence supports the optimization of good oral hygiene and elimination of dental disease in order to reduce frequency of bacteremia caused by routine daily activities like tooth brushing and flossing, (Roberts, 1999).

Many existing guidelines have discussed the importance of good oral health for reduction of the risk of endocarditis (Gould et al., 2006, Wilson, et al., 2007). In at risk patients of IE; all guidelines agreed upon the need for at risk patients of IE to establish optimal oral health and maintain regular preventive dental visits in order to reduce the occurrence of bacteraemia caused by daily activities such as oral hygiene procedures. Although a responsibility of the patient, the treating medical and dental practitioners should offer such advice (Daly, et al., 2008).

2.2.3 Antimicrobial mouth-rinses

It is reasonable to think that antibacterial mouth-rinses decrease the load of Gram-positive bacteria in the mouth and therefore may decrease the incidence and nature of bacteremia from oral procedures. However, the scientific evidence suggests that their use does not decrease the incidence and nature of bacteremia (Lockhart, 1996).

It is not known whether mouth-rinses decrease the magnitude of bacteremia, which could have some effect on the risk of IE. Nevertheless, the British Society for Antimicrobial Chemotherapy (Gould, et al., 2006) recommended the use of a pre-operative mouthwash of chlorhexidine gluconate (0.2%) for 1 minute where practicable.

2.3 Antibiotic prophylaxis

2.3.1 Rationale for antibiotic prophylaxis

IE usually follows episodes of bacteremia, which might be a result of certain interventional procedures. The bacteria is usually sensitive to antibiotics, and therefore it seems logical to prescribe antibiotics for patients with heart disease before procedures that may cause bacteremia.

2.3.2 Efficacy of antibiotic prophylaxis

IE is a serious condition and it is reasonable to be highly alert and use any possible means to prevent such condition. Therefore, antibiotic prophylaxis to prevent IE has been recommended in at-risk patients since 1955 (Jones, et al., 1955). However, there is a lack of published data that demonstrate benefits from prophylaxis against IE prior to bacteremia producing procedures.

Also, it is difficult to plan and execute research using experimental study designs, with a rare but serious condition such as IE. Consequently, the evidence available in this area is limited, being drawn chiefly from observational (case–control) studies. Nevertheless, for the past 50 years, the American Heart Association (AHA) has been recommending antimicrobial prophylaxis to prevent IE in patients with underlying cardiac conditions who underwent bacteremia producing procedures despite the scarcity of scientific evidence.

The efficacy of antibiotic prophylaxis to prevent or reduce bacteremia after a dental procedure is controversial (Lockhart and Durack, 1999). Some studies reported a reduction in the frequency, nature, and/or duration of bacteremia (Lockhart, et al., 2004, Shanson, et. al., 1985) while others did not (Hall, et al., 1993, Hall, et al., 1995, Lockhart and Durack, 1999).

In addition, some studies suggested that amoxicillin therapy had a statistically significant impact on reducing the incidence, nature, and duration of bacteremia from dental procedures, but it did not eliminate bacteremia (Lockhart, 1996, Lockhart, et al., 2004). However, no data showed that reduction of bacteremia as a result of amoxicillin therapy reduces the risk of or prevents IE.

2.3.3 Available evidence

The AHA guidelines acknowledged the relative absence of high-quality data to support recent practice recommendations (Wilson, et al., 2007). The new guidelines may appear wide sweeping and very restrictive in not recommending antimicrobial prophylaxis for many patients with cardiac lesions. However, they provide a pragmatic and reasonable approach supported by the best available evidence. The guidelines are based on

consensus and compromise, balancing the absence of solid evidence with the catastrophic consequences of IE in high-risk patients.

Although the AHA has criticized its own previous guidelines as being based on minimal published data or on expert opinion, the same criticism holds true for the current American and UK guidelines.

2.3.4 Recommended Antibiotic regimen

Despite the controversy regarding the risk of individuals developing bacterial endocarditis of oral origin, numerous expert committees in different countries continue to publish prophylactic regimens for the prevention of bacterial endocarditic secondary to dental procedures.

For half a century, between 1955 and 2007, the alterations to antibiotic guidelines in various countries related mainly to antibiotic choice and route of administration. The use of intramuscular injections or intravenous infusions of antibiotics such as penicillin, vancomycin, gentamicin and erythromycin was gradually replaced with an oral route of administration, with a single dose of amoxycillin or clindamycin given prior to treatment. The recommendation for post-treatment antibiotic administration was abolished by the AHA in 1997 (Table 2).

Table 2. The AHA recommended IE antibiotic prophylaxis regimens from 1955 to 2007

Reference	Primary Regimens for Dental Procedures
Jones, et al., 1955.	Aqueous penicillin 600 000 U and procaine penicillin 600 000 U in oil containing 2% aluminum monostearate administered intramuscularly (IM) 30 minutes (min) before the operative procedure.
Rammelkamp, et al.,1957.	For 2 days before surgery, penicillin 200 000-250 000 U by mouth 4 times per day. On day of surgery, penicillin 200 000 to 250 000 U by mouth 4 times per day and aqueous penicillin 600 000 U with procaine penicillin 600 000 U IM 30 to 60 min before surgery. For 2 days after, 200 000 to 250 000 U by mouth 4 times per day.
Committe on prevention of Rheumatic fever and bacterial Endocarditis, 1960.	Step I: prophylaxis 2 days before surgery with procaine penicillin 600 000 U IM on each day. Step II: day of surgery: procaine penicillin 600 000 U IM supplemented by crystalline penicillin 600 000 U IM 1 hour (hr) before surgical procedure. Step III: for 2 days after surgery: procaine penicillin 600 000 U IM daily.
Wannamaker, et al.,1965.	Day of procedure: procaine penicillin 600 000 U, supplemented by crystalline penicillin 600 000 U IM 1-2 hrs before the procedure. For 2 days after procedure: procaine penicillin 600 000 U IM each day.
Rheumatic Fever Committee & the Committee on Congenital cardiac defects, 1972.	Procaine penicillin G 600 000 U mixed with crystalline penicillin G 200 000 U IM 1 hr before procedure and once daily for the 2 days after the procedure.
Kaplan, et al., 1977.	Aqueous crystalline penicillin G (1 000 000 U IM) mixed with procaine penicillin G (600 000 U IM) 30-60 min before procedure and then penicillin V 500 (milligrams) mg orally every 6 hrs for 8 doses.
Shulman, et al., 1984.	Penicillin V 2 grams (g) orally 1 hr before, then 1 g 6 hrs after initial dose.
Dajani, et al., 1990.	Amoxicillin 3 g orally 1 hr before procedure, then 1.5 g 6 hrs after initial dose.
Dajani, et al., 1997.	Amoxicillin 2 g orally 1 hr before procedure.
Wilson, et al., 2007.	Amoxicillin 2 g orally 1 hr before procedure.

2.4 Infective endocarditis prophylaxis guidelines

2.4.1 Historical background

To help and support medical practitioners in a rational use of antibiotic prophylaxis, international and national societies have issued guidelines for the prevention of IE based on the quality of available evidence and the resultant risk of morbidity and mortality for ‘‘at-risk’’ patients.

The AHA published the first document on the prevention of bacterial endocarditis associated with dental procedures in 1955 (Jones, et al., 1955). Since then, many expert committees in different countries have released different prophylactic regimens. In 1995, the European Society of Cardiology (ESC) together with a group of experts from the International Society of Chemotherapy published a European consensus on bacterial endocarditis prophylaxis (Leport, et al., 1995).

In 2002, the French were the first to make drastic modifications on their 1992 consensus conference on IE prophylaxis against IE (French Recommendations, 2002) (Table 3). In 2004, both the ESC and the British Cardiac Society (BCS), together with the Royal College of Physicians of London, drew up guidelines on the prevention of bacterial endocarditis associated with dental procedures (Horstkotte, et al., 2004).

Also, the British Society of Antimicrobial Chemotherapy (BSAC) published its first antibiotic prophylaxis regimens for bacterial endocarditis in 1982 (Antibiotic prophylaxis of infective endocarditis, 1982). Later, these regimens were revised and modified in 1986 (Simmons et al., 1986), 1990 (Antibiotic prophylaxis of infective endocarditis, 1990), 1992 (Simmons *et al.*, 1992), and 2006 (Gould et al., 2006).

Furthermore, the AHA has published nine bacterial endocarditis prophylaxis protocols (Table 2).

2.4.2 Current IE prophylaxis paradigm

There is a shift in opinion reflected in national and international clinical guidelines for prophylaxis against IE. In the past, guidelines used to recommend antibiotic prophylaxis for patients with a wide range of cardiac conditions prior to a number of dental and non-dental interventional procedures. They now tend to recommend antibiotic prophylaxis for a small number of high-risk cardiac conditions when at risk patients undergo a limited number of specified dental procedures.

The most recent bacterial endocarditis prophylaxis guidelines published by the French recommendations, BCS, BSAC, the AHA and the National Institute for Health and Clinical Excellence (NICE) are summarized in Table 3.

Antibiotic regimens recommended by The European Society of Cardiology (ESC), BSAC, BCS and the AHA are listed in Table 4.

Table 3. French recommendations (2002), BSAC (2006), BCS (2004), AHA (2007) and NICE (2008) guidelines for antibiotic prophylaxis before dental procedures to prevent IE

Guidelines	High-risk cardiac conditions requiring antibiotic prophylaxis	Dental procedures requiring antibiotic prophylaxis
French recommendations, 2002.	-Previous IE -Prosthetic valve -Non-operated cyanotic CHD -Surgical bypass (pulmonary-systemic)	All invasive dental procedures.
The British Society of Antimicrobial Chemotherapy (BSAC) (Gould, et al., 2006)	- Previous IE. - Cardiac valve replacement surgery, i.e., mechanical or biological prosthetic valves. - Surgically constructed systemic or pulmonary shunts or conduits.	All dental procedures involving dento-gingival manipulation.
The British cardiac society (BCS) (Ramsdale, et al., 2004)	**HIGH RISK: CLASS I** -Prosthetic heart valves -Previous infective endocarditis -Complex cyanotic congenital heart disease -Transposition of great arteries -Fallot's tetralogy -Gerbode's defect -Surgically constructed systemic pulmonary shunts or conduits -Mitral valve prolapse with mitral regurgitation or thickened valve leaflets **MODERATE RISK: CLASS II** -Acquired valvular heart disease -Aortic stenosis -Aortic regurgitation -Mitral regurgitation - ventricular septal defect -Bicuspid aortic valve -Primum atrial sepal defect -Patent Ductus Arteriosus -Aortic root replacement -Coarctation of aorta -Atrial septal aneurysm/patent foramen ovale -Ventricular septal defect -Hypertrophic obstructive cardiomyopathy -Subaortic membrane	-Periodontal probing. -Sialography. -Intraligamental anesthesia. -Polishing teeth with a rubber Cup. -Irrigation with water jet. -Light & deep scaling. -Scaling teeth with hand instrument. -Scaling with ultrasonic instrument. -Extractions and fillings. -Matrix band and wedge. -Gingival retraction cord. -Rubber dam. -Mucoperiosteal flap. -Root planning. -Antibiotic fibres or strips placed subgingivally. -Gingivectomy. -Periodontal Surgery. -Avulsed tooth replantation. -Root canal beyond root apex. -Dental implants. -Tooth separation.

The American Heart Association (AHA). (Wilson, et al., 2007)	- Prosthetic cardiac valve - Previous IE. - Congenital heart disease (CHD): [i] a- Unrepaired cyanotic CHD, including palliative shunts and conduits b- Completely repaired congenital heart defect with prosthetic material or device, whether placed by surgery or by catheter intervention, during the first 6 months after the procedure [ii] c- Repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (which inhibit endothelialization) - Cardiac transplantation recipients who develop cardiac valvulopathy.	All dental procedures that involve manipulation of gingival tissue or the periapical region of teeth or perforation of the oral mucosa.[iii]
NICE, 2008	None	None

i. Except for the conditions listed above, antibiotic prophylaxis is no longer recommended for any other form of CHD.

ii. Prophylaxis is recommended because endothelialization of prosthetic material occurs within 6 months after the procedure.

iii. The following procedures and events do not need prophylaxis: routine anesthetic injections through noninfected tissue, taking dental radiographs, placement of removable prosthodontic or orthodontic appliances, adjustment of orthodontic appliances, placement of orthodontic brackets, shedding of primary teeth, and bleeding from trauma to the lips or oral mucosa.

Table 4. Bacterial endocarditis prophylaxis protocol (oral/parenteral regimen) for dental procedures recommended by ESC, BCS, BSAC and the AHA.

Reference	Oral regimen	Parenteral regimen
ESC (Horstkotte, et al., 2004)	-Not allergic to penicillin: 2 g of amoxicillin 1 hr) before treatment. -Allergic to penicillin: 600 mg of clindamycin 1 hr before treatment 500 mg of azithromycin or clarithromycin 1 hr before treatment	-Not allergic to penicillin: 2 g of ampicillin or amoxicillin intravenous (IV) 30-60 min before treatment
BSAC (Gould, et al., 2006) *	-Not allergic to penicillin: 3 g of amoxicillin 1 hr before treatment -Allergic to penicillin: 600 mg of clindamycin 1 hr before treatment -Unable to swallow capsules: 500 mg of azithromycin 1 hr before treatment	-Not allergic to penicillin: 1 g of amoxicillin IV just before treatment or at induction of anesthesia. -Allergic to penicillin: 300 mg of clindamycin IV just before treatment or at induction of anesthesia.
BCS (Ramsdale, et al., 2004)	-Not allergic to penicillin: 3 g of amoxicillin 1 hr before treatment -Allergic to penicillin: 600 mg of clindamycin 1 hr before treatment -Unable to swallow capsules: 500 mg of azithromycin 1 hr before treatment	-Not allergic to penicillin: 2 g ampicillin or amoxicillin IV at induction. -Allergic to penicillin: 300 mg of clindamycin (IV) at induction of anesthesia 150 mg of clindamycin (oral or IV) 6 hrs after the first dose.

Reference	Oral regimen	Parenteral regimen
AHA (Wilson, et al. 2007)	-Not allergic to penicillin: 2 g of amoxicillin 1 hr before treatment -Allergic to penicillin: 2 g of cefalexin 1 hr before treatment or 600 mg of clindamycin 1 hr before treatment or 500 mg of azithromycin or clarithromycin 1 hr before treatment.	-Not allergic to penicillin: 2 g of ampicillin IM or IV, 30 min before treatment -Allergic to penicillin: 1 g of cefazolin or ceftriaxone IM or IV, 30 min before treatment or 600 mg clindamycin IM or IV, 30 min before treatment.

*If a patient requires sequential dental procedures, they should ideally be performed at least 14 days apart to allow healing of oral mucosal surfaces. However, Gould, et al., (2006) suggested alternating amoxicillin and clindamycin, if additional dental procedures cannot be deferred.

2.4.2.1 A shift in dental procedures requiring prophylaxis

Earlier guidelines recommended antibiotic prophylaxis for dental procedures inducing bleeding but not for procedures where bleeding was not anticipated (Wilson, et al., 2007). However, no data show that visible bleeding during a dental procedure is a reliable predictor of bacteremia (Roberts, 1999). This vagueness in previous AHA guidelines led to additional uncertainties among healthcare providers about which dental procedures require prophylaxis.

2.4.2.2 A shift in Cardiac conditions requiring prophylaxis

Previous AHA guidelines categorized underlying cardiac conditions associated with the risk of IE as those with high, moderate, and negligible risk and recommended prophylaxis for patients in the high- and moderate-risk categories (Dajani, et al., 1997). In its most recent guidelines (Wilson, et al., 2007), the committee indicated the conditions with the highest predisposition to the acquisition of endocarditis over a life time and the highest risk of adverse outcome from endocarditis. Cardiac conditions that require prophylaxis in the recent AHA (2007) guidelines are listed in Table 3.

In 2006, the British Society for Antimicrobial Chemotherapy recommended a big shift from the traditional conviction that all patients at risk of IE needed antibiotic prophylaxis before dental procedures (Gould, et al., 2006). The number of cardiac conditions requiring antibiotic prophylaxis came down to only those individuals with previous IE, those who underwent cardiac valve replacement surgery or had surgically constructed systemic or pulmonary shunts or conduits. Patients with rheumatic heart disease or mitral valve prolapse no longer need to receive antibiotic prophylaxis (Daly, et al., 2008, French recommendations, 2009, Gould, et al., 2006, Wilson, et al., 2007).

In 2007, the AHA introduced new guidelines which were significantly different from previous AHA recommendations (Wilson, et al., 2007). The new American guidelines, like the British guidelines (Gould, et al., 2006), considerably made the list of cardiac conditions requiring antibiotic prophylaxis prior to dental procedures short.

Prophylaxis is only required for cardiac conditions that have the highest risk of an adverse outcome if IE occurs, rather than on the basis of lifetime risk of IE. These conditions include previous IE episode, prosthetic cardiac valves, some specific congenital heart diseases, and cardiac transplant recipients who develop cardiac valvulopathy.

The more recent UK guidelines have shifted the recommendations even further. The National Institute for Health and Clinical Excellence guidelines (NICE, 2008) did not recommend antibiotic prophylaxis against IE for any patient, regardless of their cardiac risk status, when undergoing dental procedures or interventional procedures of the gastrointestinal, genitourinary or respiratory tracts. Moreover, the NICE guidelines recommend that chlorhexidine mouthwash should not be used as prophylaxis against IE prior to dental procedures (NICE, 2008).

The NICE guidelines argued the need for prophylaxis based on the fact that no consistent association was found between interventional procedures, whether dental or non-dental, and the development of IE. In addition, the repetitive bacteraemia episodes associated with regular toothbrushing almost certainly presents a greater risk of IE development than a single dental procedure (NICE, 2008, Wilson, et al., 2007).

Implementation of this latest guideline might cause a challenge for both patients and practitioners as this violates their long standing prophylaxis practices. Furthermore, a better strategy to help dentists in getting the message across to their cardiac patients should be further evaluated.

In Australia, the UK guidelines were cautiously revised and it was decided that the elimination of antibiotic prophylaxis for all patients at risk of IE could not be recommended at the time (Daly, et al., 2008). On the other hand, the American Heart Association guidelines (Wilson, et al., 2007) were adopted with the addition of rheumatic heart disease to the list of cardiac conditions requiring prophylaxis, because of the high incidence of rheumatic heart disease among Indigenous Australians compared to Americans.

In Canada, the AHA (2007) guidelines for the prevention of IE were strongly supported and endorsed (Embil and Chan, 2008), and considered as a reasonable compromise between solid science and common sense.

2.5 Dentists' knowledge of IE prophylaxis

Because IE is a life-threatening disease, knowledge and compliance with recent recommendations among health care providers is required. Additionally, insufficient knowledge can result in an overuse of antibiotics, with the consequential risks of toxicity and emergence of resistant strains of microorganisms.

The recent substantive changes in IE prophylaxis guidelines may have violated dental practitioner's long-standing experience and practices. There is no doubt that some dental practitioners will be resistant to the change in guidelines and will still support antibiotic prophylaxis regimens previously recommended. This can be observed particularly if the practitioner underestimates the likelihood of antibiotic adverse reactions and the broader community issue of bacterial resistance.

The embracement of the new prophylaxis guidelines by health professionals should be further evaluated and more light should be shed over the knowledge and implementation of such practice recommendations.

Many studies were conducted over the years in a number of countries, to assess the knowledge and the prescribing practices among different target groups. In 2008, Zadik and co-workers conducted a study to evaluate the knowledge and implementations of the AHA guidelines (Wilson, t al., 2007) for the prevention of IE among a group of practicing dentists and found that a relatively high level of knowledge of the new guidelines was found, reflecting both familiarity of the practitioners with the guidelines and acceptance of guidelines. Prophylactic need was ambiguous during restorative, endodontic and prosthetic procedures (Zadik, et al, 2008).

Another related study in Northwest of Iran (Eskandari et al., 2008) had investigated the level of knowledge of general dental practitioners including cardiac diseases requiring prophylaxis, dental procedures requiring prophylaxis, and antibiotic regimen prescribed for endocarditis prophylaxis. The level of participants' knowledge in these three areas was 63.7%, 66.8% and 47.7%, respectively. Their overall level of knowledge regarding endocarditis prophylaxis was 59%. On a different target group, another study in Iran tried to assess the knowledge of the 1997 AHA recommendations for prevention of bacterial endocarditis among a group of Iranian dental and medical students. Only 25% of the participants passed the test successfully and had an acceptable level of knowledge of the 1997 AHA guidelines (Zarei, et al., 2008).

Knowledge and practices of IE prophylaxis were assessed in different countries. In a study carried out among Brazilian dentists, only 33% followed the American Heart Association guidelines (Coutinho, et al., 2009), whereas in Greece only 2% of dentists and physicians were found to abide by the 1992 guidelines of the BSAC (Panos, et al., 1996).

In another similar study, a generalized awareness (94.58%) among general dental practitioners in India regarding the dental etiology of IE was observed (Azarieh, et al., 2007). Nevertheless, the knowledge of IE prophylaxis was very poor as only 13% of Indian dentists had good knowledge, 36.82% had average knowledge and 50.18% were considered to have poor knowledge.

A recent study was conducted to compare the knowledge and application of current expert recommendations on antibiotic prophylaxis to prevent IE between British and Iranian dentists (Soheilipour, et al., 2009). The results revealed that 87% of British dentists followed the British national formulary guidelines and showed good compliance with the guidelines in their practices. On the other hand, 75% of Iranian

dentists claimed that they followed the AHA guidelines while they poorly abide by them in their practices. In the UK, the main sources of information on IE prophylaxis were medical and dental journals, whereas Iranian dentists obtained their prophylaxis knowledge through academic meetings, colleagues' recommendations and textbooks.

In a survey to determine prescribing practices of Canadian general dental and medical practitioners in Alberta, dentists and physicians were significantly different in using the correct antibiotic for IE prophylaxis (amoxicillin) (95% and 71% resepectively) and in prescribing the correct dose and timing of amoxicillin (2 g, 1 hour before treatment) (88% and 48% respectively) (Lauber, et al., 2007). Similarly, a large survey among 2,542 licensed Canadian dental practitioners in British Columbia reported that amoxicillin was the antibiotic of choice among 89.3 of the participants (Epstein, et al., 2000).

On the contrary, Nakano and Ooshima (2010) found that only 14% of surveyed Japanese dentists did use amoxicillin as prophylactic antibiotic for IE with wide variations in dosage and timing.

In an investigation of the knowledge and application of available guidelines on antibiotic prophylaxis for IE among Irish general dental practitioners and cardiologists, dentists were good in identifying procedures that could place their patients at risk but less informed about which cardiac conditions warranted prophylaxis (Boyle, et al., 2006).

In 2000, the prescribing habits and knowledge of a randomly selected 10% sample of South Australian general dental practitioners were analyzed. The main dental procedures requiring prophylaxis were accurately identified by over 90% of respondents but only 53 % identified rubber dam placement as a high risk procedure (Jaunay, et al., 2000).

A unique study on Swedish general dental practitioners (GDPs) had evaluated the level of confidence in dentists' decision to administer antibiotic prophylaxis rather than their knowledge of IE prophylaxis (Ellerval, et al., 2008). GDPs' exhibited an overall high levels of confidence in their decisions, regardless of whether they chose to administer antibiotics or not, or whether their decisions were according to recommendations or not.

In the Arab countries, two studies were conducted to determine the rationale and the pattern of antibiotic prescription for dental management in Kuwait (Salakoa, et al., 2004), and Yemen (Alharoni and Skaug, 2007). Both studies did not tackle the subject of IE prophylaxis knowledge and practices among targeted dentists.

A summary of all previous studies conducted to assess dentists prescribing practices and knowledge is listed in Table 5.

Table 5. Studies carried out to examine the knowledge and prescribing practices of dentists regarding antibiotic use

Author(s)	Study	Target population	Sample size
Nakano and Ooshima, 2010.	Common knowledge regarding prevention of IE among general dentists in Japan.	Dentists who graduated from Osaka University Faculty of Dentistry/ Japan.	159 GDP.
Soheilipour, et al., 2010.	Implementation of Clinical Practice Guidelines in Dental Settings	Dentists in the UK & Iran	UK: 397 dentists Iran: 200 dentists
Coutinho, et al., 2009.	Knowledge and practices of dentists in preventing infective endocarditis in children	Dentists working at two public hospitals in Brazil caring for children with special needs and cardiac conditions.	21 dentists
Zadik, et al., 2008.	Dentists' knowledge and implementation of the 2007 AHA guidelines for prevention of IE.	Practicing dentists.	118 dentists
Zarei, et al, 2008.	Assessment of awareness of recommendations for prevention of bacterial endocarditis among Iranian dental and medical students.	Dental and medical students who had passed a theoretical course about IE successfully before.	74 medical students and 62 dental students
Ellervall, et al., 2008.	How confident are GDPs in their decision to administer antibiotic prophylaxis? A questionnaire study.	GDPs in Sweden	101 GDPs
Eskandari, et al., 2007.	Endocarditis Prophylaxis in Cardiac Patients: Knowledge among General Dental Practitioners in Tabriz.	General dental practitioners in Tabriz, Northwest of Iran.	150 GDPs
Azariah et al, 2007.	Awareness of prophylaxis against IE among general dental practitioners-a knowledge attitude and practice study.	General dental practitioners in the state of Tamil Nadu/India.	

Lauber, et al., 2007	Antibiotic Prophylaxis Practices in Dentistry: A Survey of Dentists and Physicians	GDPs and family physicians in Alberta Canada	GDPs: 450 Physicians: 245
Alharoni & Skaug, 2006.	Knowledge of prescribing antimicrobials among Yemeni general dentists.	GDPs in 3 major governorates in Yemen.	150 dentists
Boyle, et al., 2006.	Antibiotic prophylaxis for bacterial endocarditis- a study of knowledge and application of guidelines among dentists and cardiologists.	Dentists and cardiologists in Ireland	Dentists: 190 Cardiologists: 27
Salako, et al., 2004.	Pattern of antibiotic prescription in the management of oral diseases among dentists in Kuwait.	Dental practitioners working in the ministry of health dental centers in Kuwait.	168 dentists
Jaunay, et al., 2000.	Antibiotic prescribing practices by South Australian general dental practitioners (GDPs)	GDPs in south Australia.	68 GDPs
Epstein, et al., 2000.	A survey of antibiotic use in dentistry	GDPs and specialists in British Colombia/ Canada.	505 dentists
Panos, et al., 1996.	Greek physicians' and dentists' compliance with the British society for antimicrobial chemotherapy (BSAC) guidelines for preventing bacterial endocarditis.	Dentists, ENT*, chest physicians, gastroenterologists, gynecologists, urologists, radiologists.	299 dentists and physicians

*ENT: Ears, nose and throat.

2.5.1 Drug of choice for IE prophylaxis

In non-penicillin allergic patients, amoxicillin is considered the first line choice of antibiotic prophylaxis for IE, recommended by all recently updated international guidelines (Gould, et al., 2006, Horstkotte, et al., 2004, Ramsdale, et al., 2004, Wilson, et al., 2007). Knowledge of dentists regarding the first-line choice of antibiotics used for IE prophylaxis is variable between different countries. It was reported to reach 89.3% in Canada's British Colombia (Epstein, et al., 2000), 95% in Canada's Alberta, (Lauber, at al., 2007), 97.4% and 96.5% in the United Kingdom and Iran respectively (Souheilipour, et al., 2010) and 14% in Japan (Nakano & Ooshima, 2010).

When patients reported penicillin allergy, clindamycin was reported as the first choice of second line drugs appropriate for preoperative prophylaxis against IE by 93% of dentists in the United Kingdom, 38% of Iranian dentists (Soheilipour, et al.,2010) , 82% of Canadian GDPs and 49% of practicing physicians in Alberta Canada (Lauber, at al., 2007). To a lesser degree, other prescribed antibiotics included azithromycin, clarithromycin, cephalexin and erythromycin.

2.5.2 Consulting the treating physician

Many dentists consult physicians regarding the need for prophylaxis and application of current regimens before performing dental procedures. Eleven percent of British dentists and 26% of Iranian dentists reported that they would always consult with another medical practitioner (Soheilipour, et al., 2010).

To date, there is no information regarding knowledge and practices of infective endocarditis prophylaxis among Jordanian dentists and this study will be the first of its kind in Jordan, and the first to investigate knowledge and practices of IE prophylaxis in the Arab countries.

MATERIALS AND METHODS

3.1 Study design and ethical considerations

The purpose of this descriptive cross-sectional study is to evaluate the knowledge and practices of antibiotic prophylaxis for IE among Jordanian dentists.

This study was carried out under supervision of the Department of Paediatric Dentistry and Orthodontics, Faculty of Dentistry, The University of Jordan during the academic year 2010/2011.

This investigation was ethically approved by the Deanship of Research of the University of Jordan.

Prior to filling the questionnaire, participants were asked to sign a written consent approving their participation in the study (Appendix 1).

3.2 Null Hypothesis

The Null hypothesis was that:

Jordanian dentists had adequate knowledge of the most recent shift in IE prophylaxis recommendations.

There are no differences between male and female Jordanian dentists, dentists working in different sectors, dentists with or without academic job involvement, GDPs and dental specialists and dentists in different age groups regarding the right antibiotic choice, preoperative dosage, preoperative timing and postoperative administration for IE prophylaxis.

3.3 Study population and sampling

The study population comprised 300 practicing Jordanian dentists, on the current dental register (178 males (59.3%) and 122 females (40.7%)), aged between 23 and 71 years (mean age 32.4 years) who were randomly selected, using a computer-generated randomization procedure, from a list of 3381 practicing dentists in Jordan obtained from Jordan Dental Association.

Practicing dentists on the dental register are distributed among different work sectors as follows: 104 employed in universities (The university of Jordan and Jordan University of Science and Technology), 204 serving within The Royal Medical Services, 508 working in the Ministry of Health and 2487 practicing in the largest sector; the private dental practice system (Private clinics, shared clinics, and dental centres). The sample was stratified according to the percentage of dentists working in each sector in all cities of Jordan. Thus; 10 dentists from universities, 20 dentists from the Royal Medical services, 44 dentists from the Ministry of Health, and 226 from the private sector were selected.

To be included in the study, the recruited dentists must be a holder of at least a BDS, DDS, or an equivalent degree and should be practicing the profession in any sector in Jordan. Dental students, dentists working abroad, retired dentists or dentists who did not complete all items of the questionnaire were excluded from the study.

Selected dentists were asked to complete the questionnaire, which was administered in English, after they were given a full explanation of the study, and an informed consent was obtained from each participant before being recruited into the study.

Participants were supplied with pens for answering the questionnaires and were asked to use their eye glasses if they have any. They were told to ask for clarification of any unclear point they might encounter while answering. Questionnaires were personally

delivered to the selected dentists at their practices and participants were asked to complete the questionnaires and were collected directly. Since the questionnaires were completed in the presence of the investigator, answers that reflect the participants' own practice and knowledge were guaranteed.

The process of questionnaires distribution and data collection took place from October 2010 until February 2011.

3.4 Questionnaire development

The development of the questionnaire engaged three phases: scale development, pilot test, and final modifications. The final product was a modified questionnaire prepared for further improvement and validation (Appendix 2).

3.4.1 Scale development

Based on previously structured questionnaires driven from related studies (Lauber, et al., 2007, Soheilipour, et al., 2010 and Zadik, et al., 2008), a questionnaire was constructed and modified to serve the specific requirements of the study. Using simple unambiguous language and keeping questions short and specific were taken into consideration so as not to overtax the respondent's memory. Leading questions (questions that suggest the answer or contain the information the examiner is looking for), double-barreled (questions that ask two questions at the same time), double negatives questions (questions that ask for level of respondent agreement to a statement that uses the word "not"), and hypothetical questions (questions that are asked out of interest, as the answer will have no effect on the situation) were avoided (Black, et al., 1998).

3.4.2 Pilot study

The questionnaire was circulated to a group of 30 experienced dental practitioners and modified based on their suggestions and comments.

The purpose of the pilot study was to assess:

(1) The format of the questionnaire including size and appearance of paper, length of the questionnaire's items, font size and style, color of paper, and the logical order of the questions.

(2) Clarity of the instructions for completing the questionnaire.

(3) Average time needed to complete the questionnaire.

(4) Ease of administration of the questionnaire.

(5) Reliability and validity of the scales.

In order to verify if the collected data from the questionnaire were valid and reliable, a formal pilot test was run during which the acceptability, validity, and reliability of the measure were tested.

Subjects who took part in the pilot study were not included in the study.

3.4.2.1 Acceptability

Acceptability was examined by asking the pilot subjects to write their comments on the questionnaire on a separate sheet or asking them by phone calls about their comments on the questionnaire. The average time needed to complete the questionnaire was 4 minutes and 30 seconds.

3.4.2.2 Reliability

Reliability can be defined as the degree to which the items of the scale measure the same thing i.e. when a procedure is applied twice the scores obtained should be in agreement (Bowling, 1995, Cooper, 1998, Cronbach, 1990, Kline, 2000).

Reliability is assessed by testing the stability of a measure over a period of time and evaluating whether the scores obtained by an individual will be steady and constant if recorded at two different occasions. If the same individual produces close or similar scores on two different occasions, then reliability is confirmed (Bowling, 1995, Kline, 2000).

A kappa coefficient with values ranging from -1 to +1 will measure the degree to which two scores, collected at two different occasions for the same person, coincide. A higher correlation coefficient indicates a higher coincidence between scores. A +1 coefficient value is the best coincidence of scores, -1 is an absence of coincidence, and 0 means there is no relationship between scores (Cooper, 1998, Kline, 2000, McCrae and Costa, 1983). The closer the test-retest reliability to 1 (100% coincidence) the more reliable the test will be.

The subjects who were chosen to take part in the pilot study answered the questionnaires twice with two weeks interval. Reliability test was carried out on all questions using kappa coefficient. The coefficients were high and ranged from 0.8-0.94.

3.4.2.3 Validity

For an instrument to be called “valid”, it needs to measure what it is supposed to measure (Black, et al., 1998).

The majority of questions used in the questionnaire were taken from already validated questionnaires from previous related studies (Jaunay, et al., 2000, Lauber, et al., 2007, Zadik, et al., 2008). The face validity of some added questions was examined by interviewing people, either face-to-face or by telephone, after completing the questionnaire to find out whether the responses given in the questionnaire agreed with their real opinions. Questions in the interview were stated differently from those in the questionnaire.

3.4.3 The final questionnaire

The questionnaire consisted of 80 items that tackled five sections including: demographic data; medical conditions requiring antibiotic prophylaxis for invasive dental procedures; dental procedures warranting antibiotic prophylaxis in a susceptible patient; mechanisms by which the dentist remains informed of current prophylactic practices and prophylactic antibiotic regimen used and other related practices. The level of knowledge of the dentists was determined based on the number of correct answers per each section.

The questionnaire was divided into four main parts. Part one of the questionnaire included 8 open questions regarding age, gender, year of graduation, place of graduation, specialty (if present), sector of practice, city or town, and current or previous academic job involvement.

Part two had three sections A, B and C. Part A contained 17 items that investigated the dentists’ prescription of prophylactic antibiotics before invasive dental treatment in

patients who suffer from 17 different most commonly encountered cardiac conditions. Participants could answer in Yes, No or I don’t know formats.

Part B included 31 questions regarding prophylactic antibiotics prescription before 31 dental procedures in an endocarditis high-risk patient. These procedures covered all aspects of dental procedures. Again, answers could be provided in Yes, No and I don’t know formats.

Part C included 4 Yes/No and multiple choice questions covering areas of dentists’ practices and opinions. The questions tested factors affecting dentists’ decisions of prophylaxis prescription, relationship of IE with oral hygiene and dental/periodontal diseases, consulting the treating physicians, and asking for a written document from the physician.

Part three of the questionnaire included 2 questions aimed to explore dentists’ source of information regarding antibiotic prophylaxis practices and the type of international guidelines they refer to in their practice, if any. Answers were provided as multiple choices.

The last part, part four, included 4 questions that embarked upon the regimen used by dentists for non penicillin-allergic patients, including the choice of antibiotic, and both preoperative and postoperative antibiotic dosage and timing of antibiotic administration.

3.5 Coding correct answers for the total questionnaire's score

Questions in part 2A, 2B and 4 were considered the ones assessing the knowledge of participants regarding IE prophylaxis, and responses to these were dichotomized into correct and incorrect answers and given the codes 1 and 0 respectively.

Correct answers were determined according to the guidelines the participants chose as the main source of information for IE antibiotic prophylaxis. Answers of I don't know formats were considered wrong answers. The maximum possible score was 52 and scores were converted to a score of 100 for an easier interpretation of data.

3.6 Statistical analysis

Data collected were coded, processed and analyzed by means of the Statistical Package for the Social Sciences (SPSS PC Version 16.0, IBM, NY, USA). Data analysis included descriptive and analytic statistics**.**

Chi-square tests were used to assess the statistical significance of different responses between two categorical variables and ANOVA statistical analysis was used to compare means of two or more groups. Statistical significance was set at $P< 0.05$.

RESULTS

4.1 Demographic Data

4.1.1 Gender, age, country of graduation and academic job involvement

The study population comprised 300 practicing Jordanian dentists who were randomly selected, using a computer-generated randomization procedure, from a list of all practicing dentists in Jordan obtained from Jordan Dental Association. Of all, 178 were males (59.3 %) and 122 females (40.7%), aged between 23 and 71 years (mean age 32.4 years). Most of the participants were graduates from universities in Arab countries (90.3%) and not involved in any previous or current academic job (72%) (Table 6).

Table 6. Demographic data among the study population (n=300)

Variables	Number of participants	Percentage
- Age:		
≤ 30 years	150	50
>30 years	150	50
- Gender:		
Male	178	59.3
Female	122	40.7
- Place of graduation:		
Arab countries	271	90.3
Others	29	7.7
- Academic job involvement:		
Yes	84	28
No	216	72

4.1.2 General dental practitioners and dental specialists

Participants included 190 GDPs and 110 dental specialists (Table 7). Specialists included 26 orthodontists, 22 oral surgeons, and 17 pediatric dentists and others as shown in Table 8.

Table 7. Distribution of the study population by type of dentist

Type of dentist	Number of participants	Percentage
GDPs	190	63.3
Specialists	110	36.7

Table 8. Distribution of dental specialists according to their specialty

Specialty	Number of participants	Percentage
Orthodontics	26	23.6
Oral surgery	22	20.0
Pediatric dentistry	17	15.5
Periodontology	13	12.0
Endodontics	12	11.0
Prosthodontics	10	9.0
Conservative dentistry	7	6.2
Preventive & Community Dentistry	1	0.9
Implantology	1	0.9
Radiology	1	0.9
Total	**110**	**100**

4.1.3. Country of obtaining specialty

More than one half of participants obtained their postgraduate degrees from universities in Arab countries (54%), followed by Western Europe (34.2%) (Table 9).

The number of years of experience for the participants ranged from 1 to 57 years (mean= 10.3 years, SD=8.44).

Table 9. Distribution of study sample by country of obtaining the specialty

Country of graduation	Number of participants	Percentage
Arab countries	60	54.1
Western Europe	38	34.2
USA	8	7.2
Eastern Europe	3	2.7
Asia	1	0.9
Australia	1	0.9
Total	**110**	**100**

4.1.4 Work sector

Of all participants, 10 dentists (3.3%) were working at Jordanian universities (The University of Jordan and Jordan University of Science and Technology), 20 dentists (6.67%) at the Royal Medical Services, 44 dentists (14.67%) at the Ministry of Health, and 226 dentists (75.33%) were practicing at the largest sector; the private sector (private clinics, shared clinics, and dental centres) (Figure 2).

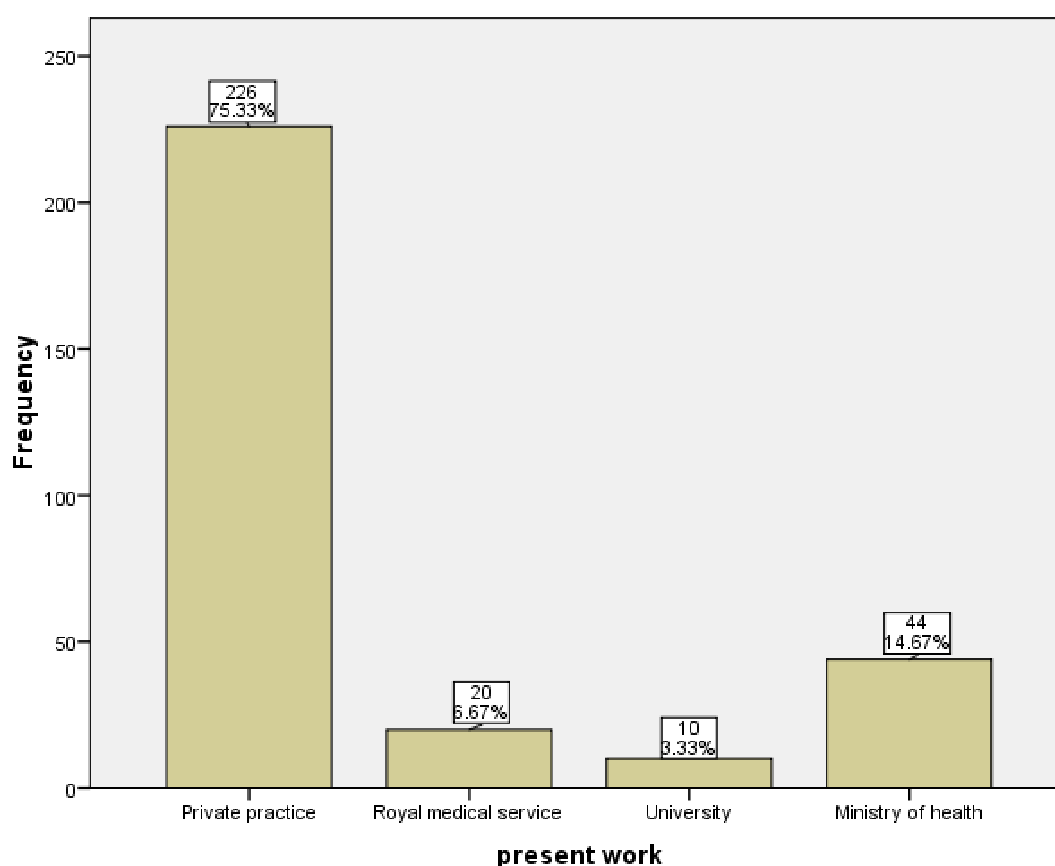


Figure 2: Distribution of study population according to their work sector.

4.2 Responses of the study population to cardiac conditions requiring IE antibiotic prophylaxis

As shown in Table 10, having a prosthetic heart valve, a previous history of endocarditis, and a cardiac transplantation procedure were correctly identified as medical conditions requiring antibiotic prophylaxis by the majority of participants (95.7%, 91% and 87% respectively). To a lesser extent, pulmonary hypertension, unrepaired cyanotic heart disease, and cardiac catheterization without stents were correctly identified. Table 10 also shows that more than half of the participants or more failed to provide the correct answers regarding prophylaxis for the following medical conditions: hypertrophic cardiomyopathy, atrial septal defect after 6 months of repair, intravascular pacemaker, ventricular septal defect with repair, patent foramen ovale, patent ductus arteriosus, previous coronary bypass, myocardial infarction in last 6 months, and pregnancy with mitral valve regurgitation. In addition, the least correctly answered condition was mitral valve prolapse with regurgitation, where only 18.7% of participants knew prophylaxis was no longer indicated as recommended by AHA, BSAC, French, Canadian and Australian recommendations.

Analysis of dentists' knowledge of the 17 cardiac conditions requiring prophylaxis showed that the percentage of correct scores ranged from 17.65% - 100% (mean = 57.1%, SD = 20.9).

Table 10. Distribution of study sample N (%) according to answers for cardiac conditions requiring prophylaxis before dental treatment

Cardiac conditions requiring prophylaxis for IE	Yes N (%)	No N (%)
Prosthetic cardiac valves	287 (95.7)	13 (4.3)
Mitral valve prolapse with regurgitation	244 (81.3)	56 (18.7)
Previous IE	273 (91.0)	27 (9.0)
Previous coronary bypass	168 (56.0)	132 (44.0)
Hypertrophic cardiomyopathy	125 (41.7)	175 (58.3)
Intravascular pacemaker	142 (47.3)	158 (52.7)
Myocardial Infarction in last 6 months	175 (58.3)	125 (41.7)
Cardiac transplantation	261 (87.0)	39 (13.0)
Unrepaired CHD	207 (69.0)	93 (31.0)
Recent coronary stents	186 (62.0)	114 (38.0)
Atrial septal defect after 6 months of repair	140 (46.7)	160 (53.3)
Ventricular septal defect with repair	147 (49.0)	153 (51.0)
Patent foramen ovale	155 (51.7)	145 (48.3)
Patent ductus arteriosus	155 (51.7)	145 (48.3)
Pregnancy with mitral valve regurgitation	190 (63.3)	110 (36.7)
Cardiac catheterization without stents (No)	113 (37.7)	187 (62.3)
Pulmonary hypertention (No)	82 (27.3)	218 (72.7)

4.3 Responses of the study population to dental procedures requiring IE antibiotic prophylaxis

Several dental procedures that do not require prophylaxis in at risk patients were correctly identified by most of the dentists including intra-oral radiographs, dental examination, fluoride treatment, shedding of primary teeth, orthodontic appliance insertion, suture removal, oral ulcers, local infiltration, oro-antral-communication, tooth preparation and impression taking and inferior dental block. However, other dental procedures were poorly recognized; these include bleeding from trauma to lips or oral mucosa, biopsy, and surgical abcess drainage (Table 11).

Regarding dental procedures that require prophylaxis in at risk patients, a high percentage of participants have correctly identified the following procedures: periodontal surgery, maxillofacial surgery, dental implants, apicectomy, surgical extraction of wisdoms, tooth extraction, root planning, crown lengthening, replantation of avulsed teeth, dento-alveolar trauma, scaling, and endodontic treatment beyond apex. Conversely, they failed to recognize the need for prophylaxis for retraction cord use, intraligamental anesthesia, matrix band placement and wedging, and rubber dam application.

The percentages of correct answers scores for the 31 dental procedures that require prophylaxis in at risk patients ranged from 41.9% to 96.77% (mean= 72.1%, SD=9.5) (Table 11).

Table 11. Distribution of study sample N (%) according to answers for dental procedures requiring IE prophylaxis for at risk patients

Dental procedures requiring IE prophylaxis	Yes N (%)	No N (%)
Dental examination	16 (5.3)	284 (94.7)
Intraoral radiographs	13 (4.3)	287 (96.4)
Shedding of primary teeth	37 (12.3)	263 (87.7)
Brushing and flossing	34 (11.3)	266 (88.7)
Fluoride treatment	20 (6.7)	280 (93.3)
Local infiltration	67 (22.3)	233 (77.7)
Intra-ligamentary anesthesia	161 (53.7)	139 (46.3)
Rubber dam	112 (37.3)	188 (62.7)
Retraction cord	164 (54.7)	136 (45.3)
Tooth preparation & impression taking	92 (30.7)	208 (69.3)
Matrix band & wedging	150 (50.0)	150 (50.0)
Endodontics beyond apex	209 (69.7)	91 (30.0)
Scaling	214 (71.3)	86 (28.7)
Root planning	261 (87.0)	39 (13.0)
Periodontal surgery	284 (94.7)	16 (5.3)
Crown lengthening	252 (84.0)	48 (16.0)
Suture removal	64 (21.3)	236 (78.7)
Inferior dental block	123 (41.0)	177 (59.0)
Biopsy	34 (78.0)	66 (22.0)
Tooth extraction	276 (92.0)	24 (8.0)

Dental procedures requiring IE prophylaxis	Yes N (%)	No N (%)
Dental implants	283 (94.3)	17 (5.7)
Apicectomy	279 (93.0)	21 (7.0)
Surgical abcess drainage	245 (81.7)	55 (18.3)
Surgical removal of third molars	278 (92.7)	22 (7.3)
Maxillofacial surgery	283 (94.3)	17 (5.7)
Orthodontic appliance	60 (20.0)	240 (80.0)
Dento-alveolar trauma	242 (80.7)	58 (19.3)
Bleeding from trauma to lips or oral mucosa	209 (69.7)	91 (30.3)
Replantation of avulsed teeth	250 (83.3)	50 (16.7)
Oro-antral communication	85 (28.3)	215 (71.7)
Oral ulcers	66 (22.0)	234 (78.0)

4.4 Factors affecting dentists' decision regarding IE prophylaxis

Participants' decision of administering antibiotic prophylaxis was not affected by patients' age (60.7%), patients' wishes (91.3%), and antibiotic cost (83%). However, only 50% of participants believed having a strong family history of heart disease should be considered when deciding the use of antibiotics for IE prophylaxis (Table 12).

Table 12. Distribution of participants N (%) according to their responses concerning factors affecting IE prophylaxis decision

Factors affecting IE prophylaxis decision	Yes N (%)	No N (%)
Age	118 (39.3)	182 (60.7)
Patients' wishes	26 (8.6)	274 (91.3)
Cost	51 (17.0)	249 (83.0)
Strong family history of heart disease	150 (50.0)	150 (50.0)

Nearly two thirds of participants believed that there was a relationship between IE and poor oral hygiene (62.7%) and dental and periodontal disease (84.7%) (Table 13).

Table 13. Distribution of participants N (%) according to their responses regarding factors related to IE

Factors related to IE	Yes N (%)	No N (%)
Poor oral hygiene	188 (62.7)	112 (37.3)
Dental periodontal disease	254 (84.7)	46 (15.3)

4.5 Referral of cardiac patients to the treating physician

Most of the participants stated that they referred their cardiac patients to their treating physicians (79.9%), and required a written document from them (73.7%).

4.6 Participants' source of knowledge about IE prophylaxis

Less than half of the participants relied on professional medical bodies, 29% based their decisions on personal experience, and another 29% followed colleagues' recommendations (Table 14).

Table 14. Distribution of participants according to their source of knowledge regarding IE prophylaxis practices

Source of knowledge regarding IE prophylaxis.	Number	Percentage
Previous academic knowledge	222	74
Professional medical bodies	126	42
Personal experience	87	29
Colleagues' recommendations	87	29

4.7 Guidelines used by participants

Fifty five percent of the participants followed the AHA guidelines, 23,7% the BCS guidelines, 10.3% NICE guidelines, 8.7% BSAC, 8.7% the ESC and 0.07% the Australian guidelines (Table 15).

Table 15. Distribution of participants according to the guidelines used

Guidelines used	Number	Percentage
American Heart Association	165	55.0
British Cardiac Society	71	23.7
National Institute for Clinical Excellence	31	10.3
British Society for Antimicrobial Chemotherapy	26	8.7
European Society of Cardiology	26	8.7

4.8 IE antibiotic prophylaxis regimen

Two hundred and seventy seven participants (92.3%) prescribed antibiotics for IE prophylaxis, only 4 (1.3%) didn't use antibiotics for IE prophylaxis, and 19 (6.3%) participants didn't know if they should practice prophylaxis against IE or not. Regarding administering postoperative dose of antibiotics in at risk patients, 136 participants (54%) reported giving postoperative IE antibiotic prophylaxis dose, 105 (35%) did not, and 32 (10.7%) did not know if a postoperative dose should be given or not.

Amoxicillin, the correct first-line antibiotic, was chosen by 74.0% of participants (73.2% of GDPs and 75.5% of specialists), followed by penicillin which was prescribed by 5.3% of participants. Table 16 shows frequencies and percentages of antibiotic agents prescribed by the participants.

Table 16. Frequency distribution of participants according to the types of antibiotics prescribed for IE prophylaxis

Type of antibiotic	Number	Percentage
Amoxicillin	222	74.0
Penicillin	16	5.3
Clindamycin	15	5.0
Erythromycin	7	2.3
Ampicillin	6	2.0
Cephalosporines	3	1.0
Lincomycin	2	0.7

Sixty one per cent of participants prescribed antibiotics for IE at the correct preoperative timing (0.5-1 hour preoperatively), 8.3 % at any time 24 hours before the dental procedure, 8% more than 24 hours before the dental procedure and 21% did not know the answer to the correct preoperative timing question.

The correct first-line dose regimen (2g or 3g) was indicated by 48.7% of participants.

Two hundred and sixty six participants (88.7%) chose the oral route for antibiotic administration (Table 17).

Table 17. Distribution of participants according to their responses to the route of antibiotic administration used for IE prophylaxis

Route	Number of participants	Percentage
Oral	266	88.7
IV	8	2.7
IM	1	0.3
I don’t know	21	7.0
I don’t give	4	1.3
Total	**300**	**100**

Regarding postoperative administration of antibiotics for IE prophylaxis, 35% of participants chose not to administer postoperative antibiotics, and 10.7% of participants did not know if a postoperative dose should be given or not.

4.9 Differences in responses to part 4 of the questionnaire according to participants' categories

4.9.1 Differences in response between GDPs and dental specialists

Using Chi-square tests, the difference between GDPs and specialists in prescribing the correct first-line antibiotic (amoxicillin) and choosing the correct preoperative timing (0.5-1 hour before dental procedures requiring prophylaxis) were not statistically significant ($p=0.384$ and 0.68 respectively).

On the other hand, differences in choosing the right preoperative dosage (2 gm or 3 gm) and the correct choice of not administering postoperative antibiotics were statistically significant ($p=0.004$ and 0.003 respectively) (Table 18). Specialists provided more correct answers regarding the right preoperative dosage and the absence for the need to administer antibiotics postoperatively.

Table 18. Distribution of GDPs and dental specialists N (%) according to the right antibiotic choice, preoperative dosage, preoperative timing, postoperative administration for IE prophylaxis

	GDPs N (%)	Specialists N (%)	P value
Types of antibiotic			
Amoxicillin	139 (73.2)	83 (75.5)	
Other	51 (26.8)	27 (24.5)	0.384
Preoperative dosage of antibiotic prophylaxis			
2 or 3 gm	81 (42.6)	65 (59.1)	0.004
Other	109 (57.4)	45 (40.9)	
Timing of antibiotic administration			
0.5-1 hour	110 (57.9)	74 (67.3)	0.068
Other	80 (42.1)	36 (32.7)	
Postoperative dosage of antibiotic prophylaxis			
No postoperative dose	55 (28.9)	50 (45.5)	0.003
Other	135 (71.1)	60 (54.5)	
Total	**190 (100)**	**110 (100)**	

4.9.2 Differences in participants' response according to age group

A higher percentage of dentists younger than 30 years of age identified amoxicillin as the first line drug for IE prophylaxis (p=0.003). Nevertheless, differences between dentists younger or older than 30 years of age in choosing the correct preoperative timing, preoperative dosage and postoperative dose were not statistically significant (p=0.203, 0.102 and 0.166 respectively) (Table 19).

Table 19. Distribution of dentists in different age groups N (%) according to their response to the right antibiotic choice, preoperative dosage, preoperative timing and postoperative antibiotic administration for IE prophylaxis

	Participants ≤ 30 years N (%)	Participants > 30 years N (%)	P value
Type of antibiotic			
Amoxicillin	122 (81.3)	100 (66.7)	0.003
Other	28 (18.7)	50 (33.3)	
Preoperative dosage of antibiotic prophylaxis			
2 or 3 gm	83 (55.3)	71 (47.3)	0.102
Other	67 (44.7)	79 (52.7)	
Timing of antibiotic administration			
0.5-1 hour	88 (58.7)	96 (64.0)	0.203
Other	62 (41.3)	54 (36.0)	
Postoperative dosage of antibiotic prophylaxis			
No postoperative dose	48 (32.0)	57(38.0)	0.166
Other	102 (68.0)	93(62.0)	
Total	150 (100)	150 (100)	

4.9.3 Differences in participants' response according to gender

One hundred and thirty one males (73.6%) chose amoxicillin as the first line antibiotic for IE prophylaxis, 60.1% chose the correct preoperative time, 52.2% chose the correct preoperative dose and 36% chose not to administer a postoperative dose.

Two thirds of females chose Amoxicillin, 63.1% chose the correct preoperative time, 43.4% chose the correct preoperative dose, and 33.6% did not provide a postoperative dose. These differences were not statistically significant (p=0.478, 0.084, 0.344 and 0.385 respectively) (Table 20).

Table 20. Distribution of participants N (%) by gender according to their response to the right antibiotic choice, preoperative dosage, preoperative timing and postoperative antibiotic administration for IE prophylaxis

	Male participants N (%)	Female participants N (%)	P value
Type of antibiotic			
Amoxicillin	131 (73.6)	91 (74.6)	0.478
Other	47 (26.4)	31 (25.4)	
Preoperative dosage of antibiotic prophylaxis			
2 or 3 gm	85 (47.8)	69 (56.6)	0.084
Other	93 (52.2)	53 (43.4)	
Timing of antibiotic administration			
0.5-1 hour	107 (60.1)	77 (63.1)	0.344
Other	71 (39.3)	45 (36.9)	
Postoperative dosage of antibiotic prophylaxis			
No postoperative dose	64 (36.0)	41 (33.6)	0.385
Other	114 (64.0)	81 (66.4)	
Total	**178 (100)**	**122 (100)**	

4.9.4. Differences in participants' response according to their practice sector:

A high percentage (74.5%) of participants who had a private practice chose amoxicillin as the drug of choice for IE prophylaxis, 49.1% chose the correct preoperative dose (2 or 3 g), 59.4% chose the correct preoperative timing for antibiotic administration (0.5-1 hour), and 33% chose not to administer postoperative antibiotics.

Also, ninety percent of participants practicing at the Royal Medical Services (RMS) chose amoxicillin, 60% chose the correct preoperative dose, 70% chose the correct preoperative timing, and 65% chose not to administer postoperative antibiotics.

Furthermore, the majority of participants practicing in universities (University of Jordan and Jordan University for science and technology) chose the correct antibiotic (78.3%), 43.5% chose the correct preoperative dosage, 68.9% chose the correct timing of antibiotic administration, and 52.2% chose not to administer postoperative dosage of antibiotics.

However, participants from the Ministry of Health (MOH) chose the correct answers to a varying degree; amoxicillin (62.2%), correct preoperative dose (44.4%), correct antibiotic timing (68.9%), and no postoperative dosage (22.2%).

Differences between participants practicing in different sectors regarding the antibiotic choice, preoperative dosage, and timing of antibiotic administration were not statistically significant ($p=0.104$, 0.657 and 0.52 respectively), while differences in the choice of postoperative dose administration were statistically significant ($p=0.002$) (Table 21). Participants who practiced in universities were the most to avoid postoperative antibiotic administration while dentists from MOH were the most to prescribe postoperative antibiotic prophylaxis.

Table 21. Distribution of participants N (%) by practice sector according to their response to the right antibiotic choice, dosage, preoperative timing and postoperative antibiotic administration for IE prophylaxis

	PS N (%)	RMS N (%)	UN N (%)	MOH N (%)	P value
Amoxicillin	158 (70.0)	18 (90.0)	9 (90.0)	28 (63.6)	0.104
2 or 3 gm	104 (46.0)	12 (60.0)	4 (40.0)	20 (45.4)	0.657
0.5-1 hour	126 (55.0)	14(70.0)	6 (60.0)	31(70.4)	0.520
No postoperative dose	70 (46.0)	13(65.0)	5 (50.0)	10 (22.7)	0.002

PS: Private sector UN: Universities

4.9.5 Differences in response between academic and non-academic participants

Participants who are/were involved in any form of academic job chose mainly amoxicillin as the drug of choice for IE prophylaxis (73.8%), only 47.6% chose the correct preoperative dose (2 or 3 grams), 63.1% chose the correct preoperative timing, and 47.6% chose not to administer postoperative IE prophylaxis dose (Table 22).

Differences between participants with and without current/previous academic job regarding the antibiotic choice, preoperative dosage, and timing of administration were not statistically significant (p=0.536, 0.461 and 0.400 respectively). However, differences between academic and non-academic participants in the postoperative antibiotic dosage were statistically significant (p=0.004) (Table 22). Those involved with academic job chose not to administer postoperative antibiotics more than non-academic participants.

Table 22. Distribution of participants N (%) with or without current/previous academic Job Involvement according to their response to the right antibiotic choice, preoperative dosage, preoperative timing and postoperative antibiotic administration for IE prophylaxis

	Academic N (%)	Non-academic N (%)	P value
Type of antibiotic			
Amoxicillin	62 (73.8)	160 (74.1)	0.536
Other	22 (26.2)	56 (25.9)	
Preoperative dosage of antibiotic prophylaxis			
2 or 3 gm	40 (47.6)	106 (49.1)	0.461
Other	44 (52.4)	110 (50.9)	
Timing of antibiotic administration			
0.5-1 hour	53 (63.1)	131 (60.6)	0.400
Other	31 (36.9)	85 (39.4)	
Postoperative dosage of antibiotic prophylaxis			
No postoperative dose	40 (47.6)	65 (30.1)	0.004
Other	44 (52.4)	151 (69.9)	
Total	**84 (100)**	**150 (100)**	

4.10 Scores of cardiac conditions and dental procedures requiring prophylaxis and total questionnaire's score

Results of correct answers for the cardiac conditions that require antibiotic prophylaxis ranged from a score of 17.7% to 100% (mean=57.1, SD=20.9). While results of correct answers for dental procedures that require antibiotic prophylaxis ranged from a score of 41.9% to 96.8% (mean=72.1, SD=9.5).

The maximum possible score for the whole questionnaire (Part 2A, Part 2B and part 4) was 100%, with respondents achieving a total score of correct answers that ranged from 37.5% to 95.83% (mean=66.74, SD=11.08).

4.10.1 Differences in mean scores between GDPs and dental specialists

The mean scores for correct cardiac and dental procedures requiring prophylaxis along with the total questionnaire's score varied between dental specialists and GDPs with specialists having the highest mean score in all three categories (62.2%, 73.4% and 69.4% respectively) (Table 23).

Data were analyzed using ANOVA and differences were found statistically significant for the cardiac procedures requiring prophylaxis results and the overall questionnaire score, ($p=0.001$ for both categories). Specialists were more able to identify cardiac procedures that require prophylaxis, however, the differences were not statistically significant for the dental procedures requiring antibiotic prophylaxis scores ($p=0.063$).

Table 23. Mean scores (out of 100) of correct answers regarding cardiac conditions requiring IE prophylaxis, dental procedures requiring prophylaxis, and overall questionnaire score among GDPS and specialists

	correct cardiac conditions mean	correct dental procedures mean	Overall questionnaire score Mean
GDPs (190)	54.1	71.2	65.2
Specialists (110)	62.2	73.4	69.4
P value	0.001	0.001	0.063

4.10.2 Differences in mean scores between different dental specialties

As shown in table 24, results varied between different dental specialties regarding correct answers for cardiac conditions requiring IE prophylaxis, dental procedures requiring IE prophylaxis and the overall questionnaire score. Radiologists, orthodontists and endodontists scored the highest mean scores regarding the correct dental procedures requiring prophylaxis, but differences were not statistically significant (p=0.366). Oral surgeons and endodontists had the highest mean scores regarding correct cardiac procedures requiring prophylaxis and the overall questionnaire score, and differences were statistically significant between different specialties for those two areas of study (p=0.016 and 0.022 respectively).

Table 24. Mean scores (out of 100) for GDPs and different dental specialties regarding correct dental procedures requiring prophylaxis, cardiac procedures and the overall score of questionnaire

		Number	Mean	P value
Dental procedures	GDPs	190	71.2733	
	Pediatric D.	17	74.9526	
	Orthodontics	26	75.3102	
	Prosthodontics	10	69.0323	
	Conservative	7	68.2028	
	Periodontics	13	72.2084	
	Surgery	22	73.6070	0.366
	Implantology	1	70.9677	
	Endodontics	12	75.2688	
	Community dentistry	1	64.5161	
	Radiology	1	77.4194	
	Total	**300**	**72.0538**	
Cardiac procedures	GDPs	190	54.0867	
	Pediatric D.	17	60.8997	
	Orthodontics	26	59.5023	
	Prosthodontics	10	58.8235	
	Conservative	7	55.4622	
	Periodontics	13	60.6335	
	Surgery	22	70.0535	0.016
	Implantology	1	29.4118	
	Endodontics	12	69.6078	
	Community dentistry	1	29.4118	
	Radiology	1	58.8235	
	Total	**300**	**57.0588**	
Overall score	GDPs	190	65.1864	
	Pediatric D.	17	69.9755	
	Orthodontics	26	69.7115	
	Prosthodontics	10	65.4167	
	Conservative	7	63.6905	
	Periodontics	13	68.1090	
	Surgery	22	72.3485	0.022
	Implantology	1	56.2500	
	Endodontics	12	73.2639	
	Community dentistry	1	52.0833	
	Radiology	1	70.8333	
	Total	**300**	**66.7431**	

Dentists within different specialties varied in choosing correct answers regarding the antibiotic prophylaxis choice, preoperative dose and postoperative antibiotic administration for IE prophylaxis (Table 25). A larger number of endodontists and pediatric dentists chose the correct postoperative dosage than the other specilists and the differences were statistically significant (p=0.049). While the largest percentages of participants with correct answers concerning antibiotic choice and the preoperative dosage belong to pediatric dentists, periodontists, endodontists and oral surgeons, yet differences were not statistically significant (p=0.447 and 0.129 respectively).

Table 25. Distribution of specialists N (%) according to the correct IE prophylaxis antibiotic, preoperative dosage and postoperative dosage

Type of dental specialty	Specialists who chose amoxicillin N (%)	Specialists who chose preoperative dose 2-3 g N (%)	Specialists who chose no postoperative administration N (%)
Pediatrics	15 (88.2)	11 (64.7)	10 (58.8)
Orthodontics	17 (65.4)	13 (50.0)	7 (26.9)
Prosthodontics	8 (80.0)	5 (50.0)	4 (40.0)
Conservative	4 (57.1)	4 (57.1)	3 (42.9)
Periodontics	12 (92.3)	9 (69.2)	7 (53.8)
Surgery	16 (72.7)	14 (63.6)	11 (50.0)
Endodontics	9 (75.0)	9 (75.0)	7 (58.3)
Community dentistry	0 (0.0)	0 (0.0)	0 (0.0)
P value	0.447	0.129	0.049

4.10.3 Differences of mean scores by gender, age, academic job involvement, and practice sector

Females scored more correct answers regarding dental procedures requiring IE prophylaxis than males, and the difference was statistically significant (p=0.001). Also, significant differences were found between participants working in different sectors regading correct cardiac conditions scores and the overall questionnaire score; participants practicing in universities and at the Royal Medical Services had scored higher than those working in private practice and the Ministry of Health (p=0.009 and 0.041 respectively).

Participants with a current or previous academic background had higher mean scores for correct answers regarding cardiac conditions requiring prophylaxis and the overall questionnaire score than non-academic participants (p=0.005 and 0.009 respectively).

Table 26 shows results of participants in all three areas; cardiac conditions requiring IE prophylaxis, dental procedures requiring IE prophylaxis, and the overall questionnaire score, according to age, gender, practice sector and academic job involvement.

Table 26. Mean scores (out of 100) for correct cardiac conditions requiring IE prophylaxis, dental procedures requiring IE prophylaxis and the overall questionnaire score according to place of practice, academic job involvement, gender and age group

	correct cardiac conditions mean	correct dental procedures mean	Overall score of the questionnaire mean
Place of Practice:			
University	68.79	74.05	72.19
Royal Medical Services	63.52	71.12	68.43
Private sector	56.04	72.23	66.49
Ministry of Health	52.94	70.60	64.35
P value	0.009	0.514	0.041
Academic job involved:			
Yes	62.46	72.23	69.41
No	54.95	71.59	65.70
P value	0.005	0.182	0.009
Gender:			
Male	57.76	70.56	66.03
Female	56.02	74.22	66.77
P value	0.480	0.001	0.181
Age Group:			
≤30 years	57.72	72.32	67.15
> 30 years	56.93	71.78	66.33
P value	0.582	0.626	0.523

DISCUSSION

Because IE is a life-threatening disease, knowledge of IE prophylaxis and compliance with recent recommendations among health care providers is required. The recent substantive changes in IE prophylaxis guidelines may have violated dental practitioner's long-standing experience and practices. This cross-sectional study evaluated the knowledge and practices of Jordanian dentists related to antibiotic prophylaxis for IE.

In Arab countries, studies on antibiotic use are scarce; one study investigated antibiotic prescription in the management of oral diseases among dentists in Kuwait (Salako, et al., 2004). Another explored the use of antibiotics for therapeutic and prophylactic reasons among dentists in Yemen (Alharoni and Skaug, 2006). Dar-Odeh, et al. (2010) published a review on antibiotic prophylaxis practices among dentists worldwide.

5.1 Subjects and sampling

The study sample was considered representative because it was randomly selected using a computer-generated randomization procedure, from a list of all practicing dentists in Jordan obtained from The Jordan Dental Association, and was demographically representative of the overall general population of registered practicing dentists in Jordan.

Related studies in other countries had used postal questionnaires to be mailed back to the examiner (Epstein et al., 2000, Jaunay, 2000, Lauber, 2007, Soheilipour, 2010). In the present study, questionnaires were personally delivered to the selected dentists at their practices and participants were asked to complete the questionnaire and the questionnaire was collected directly. This method of questionnaire distribution may have also avoided the shortcoming of having low response rates associated with postal

questionnaires; as medical research has suggested that the reason for non-response to postal surveys is that questionnaires are lost in other paperwork, routinely thrown away, or practitioners are too busy to fill them out (Kaner et al., 1998).

Similar to any questionnaire-based survey, there is no assurance that what practitioners reported in their survey responses corresponds with what they do on daily basis in their practices. However, as there was seemingly no incentive to respond dishonestly to an anonymous survey, one would assume that professional practitioners would be as truthful as possible.

5.2. Consulting the treating physician

The issue of IE antibiotic prophylaxis prior to dental procedures might be more relevant to dentists as it pertains to their everyday procedures, requiring them to be more informed and confident of their IE prophylaxis practices.

The results of this survey highlighted that 79.9% of participants would seek advice from patients' treating physician regarding the need for IE prophylaxis and application of current regimens before performing dental procedures. Just as the typical dentist would not be aware of the specifics of physicians' procedures, a physician cannot be faulted for not knowing specifics of dental procedures, and their antibiotic prophylaxis needs. It is necessary to ensure that practicing dentists as well as physicians remain updated to prevent development of potentially avoidable sequelae (IE) or development of drug resistance due to inaccurate prescribing habits. Therefore, it would be valuable to investigate the level of knowledge and understanding of this topic between these two groups in further research.

Buckingham, et al. (1992) found that 63% of dentists felt that communication between them and the patients' doctor was unsatisfactory and that most of them were informed

about the patients' cardiac conditions by the patients themselves rather than having information on the cardiac disorder from well-documented records of the patients' treating physicians.

5.3 Relationship between IE and Oral hygiene and periodontal disease

A high percentage of participants believed that a relationship existed between IE on one hand, and poor oral hygiene, dental and periodontal disease on the other. While the presumed relationship is controversial, available evidence supports an emphasis on maintaining good oral hygiene and eradicating dental disease to decrease the frequency of bacteremia from routine daily activities (Gould, et al., 2006, Wilson, et al., 2007). Thus, it is fundamental to provide the patient with information about the mechanisms that cause bacteremias of oral origin and the dangers of inappropriate prophylaxis practices and unjustified antibiotics intake. It should be emphasized that the real risks of transient bacteremias are those which occur on a daily basis, if there is inadequate oral hygiene.

5.4 Cardiac and dental procedures requiring IE prophylaxis

Prophylaxis is recommended for individuals who have a higher risk for developing IE than the general population, and is particularly important for individuals in whom IE is associated with high morbidity and mortality (Wilson, et al., 2007, NICE, 2008).

The findings from the present study suggested that the key cardiac conditions (prosthetic heart valve, a previous history of endocarditis, and a cardiac transplantation procedure), were highly specified by participants as conditions requiring antibiotic prophylaxis. This concurs with the findings of Jaunay (2007) and Souheilipour (2010).

This level of knowledge was lower for other conditions. Patients with hypertrophic cardiomyopathy, atrial septal defect after 6 months of repair, intravascular pacemaker, ventricular septal defect with repair, patent foramen ovale, patent ductus arteriosus, previous coronary bypass, myocardial infarction in last 6 months, and pregnancy with mitral valve regurgitation were considered for antibiotic prophylaxis by 35-58% of the study sample.

The least correctly answered condition was mitral valve prolapse with regurgitation, where only 18.7% of participants knew that prophylaxis was no longer indicated as recommended by AHA in 2007 (Wilson, et al., 2007), BSAC (Gould, et al., 2006) French recommendations in 2002, Canadian recommendations (Embil and Chan, 2008) and Australian recommendations (Daly, et al., 2008). This cardiac condition was previously considered an IE moderate risk group in the previous recommendations, but not in the last international guidelines update.

In this study, the low level of knowledge related to cardiac conditions requiring IE prophylaxis could be explained by that a high percentage of participants prescribed antibiotic prophylaxis for IE based on their previous academic knowledge more than relying on professional medical bodies. This means that participants relied in their

everyday clinical practice upon the knowledge they received through their primary academic basic studies, being oblivious of updates in universal guidelines. An issue that can be overcome with compulsory educational courses of the latest updates in dental/medical issues, guaranteeing safe and effective patients' care.

Most of dental procedures that do not require prophylaxis in at risk patients were correctly identified by most of participants. However, confusion about prophylactic guidelines may explain the pattern of over prescription of antibiotics and the poor knowledge of the correct IE prophylaxis practices for some dental procedures including bleeding from trauma to lips or oral mucosa, biopsy, and surgical abcess drainage. Furthermore, participants failed to recognize the need for prophylaxis with fairly common dental procedures such as retraction cord use, intraligamental anesthesia, matrix band and wedging placement, and rubber dam application.

Jaunay et al. (2000) reported that rubber dam placement was also the least correctly identified dental procedure requiring IE prophylaxis. However, the number of dentists who recognized it in their study was higher than in the present study (53%). Vagueness in previous IE guidelines may have caused these uncertainties among healthcare providers regarding which dental procedures require prophylaxis and which do not.

Although one of the goals of updating the guidelines was to simplify it and resolve ambiguities and inconsistencies (Delaheye, et al., 2009, Gould, et al., 2006, Wilson, et al., 2007) they gave a general description of procedures warranting IE prophylaxis; "all dental procedures that involve manipulation of the gingival tissue or the periapical region of teeth or perforation of the oral mucosa," and specified a limited number of procedures that do not need IE prophylaxis (Wilson, et al., 2007). These procedures included routine anesthetic injections, dental radiographs, placement of removable prosthodontic or orthodontic appliances, placement of orthodontic brackets, shedding

of deciduous teeth, bleeding from trauma to the lips or oral mucosa, biopsies, suture removal, and placement of orthodontic bands. However, these guidelines left other dental procedures for the clinician's judgment. Further research is needed to establish detailed practical evidence-based guidelines, where procedures that require prophylactic antibiotics should be listed in details, as in the case of the BCS guidelines (Ramsdale, et al, 2004).

In this study, participants' knowledge of dental procedures that need IE antibiotic prophylaxis was higher than their knowledge of cardiac conditions requiring IE prophylaxis. This was reflected by a higher number of correct answers regarding the dental procedures questions (mean= 72.1), compared to the cardiac conditions requiring prophylaxis questions (mean = 57.1). This higher level of knowledge in dental procedures requiring prophylaxis is probably due to the fact that the recommended dental procedures requiring IE prophylaxis did not change much in the past decade.

Confusion over medical conditions or dental procedures requiring IE antibiotic prophylaxis in the guidelines may explain the large number of antibiotic prescriptions suggested for prophylaxis where there is no compelling evidence for their necessity.

When compared to the finding of other similar studies, knowledge of participants with cardiac conditions requiring prophylaxis was lower in our sample than the results obtained in 2008 by Eskandari and higher for dental procedures score. In this study, the lower level of participants' knowledge regarding cardiac conditions needing prophylaxis could be the result of using more comprehensive questionnaire with more specialized questions and wider selection of cardiac conditions, or an actual deterioration in the level of knowledge of dentists.

In general, specialists got better overall questionnaire scores than GDPs. Oral surgeons and endodontists had the highest score among all. This could be attributed to a higher

antibiotic demand these two categories of specialists have to confront in their daily practice, thus keeping them more informed and updated about judicious antibiotic use.

Participants working at universities and the Royal Medical Services demonstrated better knowledge of cardiac conditions requiring IE prophylaxis than participants who worked at the private sector and the Ministry of Health, and higher awareness was observed regarding the lack of need for a postoperative antibiotic dosage. This can also be said about participants with previous academic job involvement compared to non-academic participants. A finding that could be attributed to the updated courses and the continuing education in the academic atmosphere in which those participants are kept.

Females were able to identify dental procedures requiring IE antibiotic prophylaxis more than males, a finding that was not studied in other studies (Eskandari, et al., 2007, Nakano and Ooshima, 2010, Soheilipour, et al., 2010, Zadik, et al., 2008). A finding that is hard to explain, yet one might be able to relate it to the more vigilant nature of females.

Gender differences were seen, however, in a study related to antibiotic prescription patterns among Yemeni GDPs (Alharoni and Skauge, 2006) where females scored less marks than males regarding antibiotic prescription practices. The authors explained this favorable and advantageous male prescription pattern was explained by that either males could be more confident than females, or females besides being introduced relatively recently to the Yemeni labor force, might be more afraid of being accused of infection sequelae of dental treatment.

5.5 IE prophylaxis Regimen

It is essential, when prescribing any medication, to be aware of the proper drug and dosing regimen to ensure proper patient care. Prophylaxis is most effective when given in doses that are sufficient to assure adequate antibiotic concentrations in the serum during and after procedure (Wilson, et al., 2007).

The present study revealed that 10.3% of participants followed the NICE 2008 guidelines, which ruled out the need for antibiotic prophylaxis prior to dental procedures. However, only 1.3% of participants stated that they do not use antibiotics for prophylaxis against IE, which means that 9% of participants chose an answer that did not really reflect their actual knowledge of the guidelines nor their actual practice.

As in the findings of Epstein et al. (2000) and Jaunay et al. (2000), the majority of the participants in this study chose amoxicillin as the first line antibiotic prophylaxis followed by penicillin, which was abandoned as the first drug choice in AHA guidelines of 1990 (Dajani, et al., 1990) as oral prophylactic regimens. However, the dose and duration of the antibiotic used varied considerably.

Some participants prescribed antibiotics once at 1 h before the procedure as recommended by the updated AHA statement (Wilson, et al., 2007), but others prescribed antibiotics any time in the same day of the procedure, or before 24 hours of the procedure divided on multiple oral intakes. This reflects a lack of knowledge of the true mechanism of antibiotic prophylaxis among those participants and probably an uncertainty of the effectiveness of a single dose regimen an hour before the procedure. More emphasis should be placed on educating dental students to increase their awareness of the pharmacologic mechanisms of antibiotic usage in general, and the antibiotic prophylaxis efficacy and regimens in particular.

Although our results seem to indicate a better understanding of prophylactic antibiotics preoperative and postoperative dosage and timing by both age groups, the correct prescription of first line IE antibiotic prophylaxis; amoxicillin, by participants less than 30 years old differed significantly ($p < 0.005$) from the prescribing choice of those who were older. This could be due to the fact that amoxicillin replaced penicillin as the choice for IE antibiotic prophylaxis only in 1990 (Dajani, et al., 1990), and those who were older than 30 years of age were not familiar with the new updates of the universal guidelines.

Although 86% of participants in this study followed the AHA, BCS and BSAC guidelines, compliance with recommendations of those guidelines was poor as the 2g dose of oral amoxicillin recommended by the current AHA (Wilson, et al., 2007) statement was prescribed by 37.7% of participants, the 3g dose recommended by BSAC (Gould, et al., 2006) was prescribed by 11% of participants, and only 35 % of participants knew that there was no need for a postoperative antibiotic dosage for IE prophylaxis. This indicates that nearly two thirds of participants practice improper IE antibiotic prophylaxis dosage, which either renders the whole concept of prophylaxis ineffective or result in an unjustified use of a whole antibiotic course.

This finding is related to a tangible lack of solid undergraduate understanding of the risks of IE, proper prophylaxis practices, and exposure to up-to-date guidelines, although the current antibiotic regimen guidelines has not changed since 1997. Additional educational programs in the form of posters and brochures should be introduced to improve the knowledge of Jordanian dentists regarding dental considerations of patients at high risk of developing IE.

Specialists' knowledge of the correct preoperative and postoperative dosage was significantly higher than that of GDPs. This finding points out the need for revisions in

the dental syllabus at the undergraduate level, to cover antibiotic prophylaxis for bacterial endocarditis more thouroughly and with more emphasis on updated guidelines.

5.6 Limitations of the study

During the formative stages of this study, some obstacles were faced. Not all selected dentists agreed on participating in the present study, so other dentists had to be randomly chosen to keep the number of participants to 300 practicing Jordanian dentists, so as to increase precision and maintain good power of the study.

As in any other questionnaire-based study, there are no guarantees that the answers of participants reflect their true opinions and practices.

CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

1. There is an over-prescription of antibiotics for prophylactic purposes due to inadequacy in updating the knowledge of IE protocols, and overestimation of the seriousness of certain low risk cardiac conditions.

2. The overall knowledge of dentists in this study was inadequate regarding IE prophylaxis regimens, and their everyday clinical practice was not necessarily based on proper scientific grounds.

3. A lack of knowledge about correct IE prophylaxis practices before some common dental procedures was found.

4. Most dentists in Jordan don't combine their previous academic knowledge with updates from periodical medical bodies as sources of information for IE prophylaxis practices.

5. Dentists, who are kept in an academic environment, had better knowledge of cardiac conditions requiring IE prophylaxis and the lack of need for a postoperative antibiotic dose.

6. Specialists have a better overall knowledge of IE antibiotic prophylaxis needs.

7. Dentists who confront a high antibiotic demand in their daily practice have more awareness of the needs of IE prophylaxis.

6.2 Recommendations

Based on these results, it appears that more effort needs to be done to improve the dissemination of knowledge about IE antibiotic prophylaxis among dentists in Jordan. To overcome the shortcomings observed in IE prophylaxis knowledge and practices we recommend the following:

1. Endorsing a specific guideline that Jordanian dentists could follow and keeping them updated regularly through Jordan Dental Association.

2. Increasing awareness of the importance of using appropriate type, dose, and prescription duration of antibiotics when indicated, as suboptimal antibiotic doses, extended duration of antibiotic use and use when not indicated (overuse) are all factors that may affect development of antibiotic resistant microorganisms

3. Additional educational means in the form of posters, brochures, and continuing education programs should be introduced to improve the knowledge of GDPs regarding IE prevention.

4. Educating dentists about their responsibility of ensuring the adequacy of patients' oral health before any elective dental treatment, as well as to inform guardians/patients about the risk of oral diseases and adverse reactions to antibiotics.

5. Investigating the level of knowledge and understanding of IE prophylaxis between dentists and physicians as both health professionals have the obligation to know current protocols of IE prophylaxis and use their own clinical judgment and coordinated efforts for the prevention of IE.

6. Further research should investigate the level of knowledge and awareness among cardiac patients and patients at risk of developing IE.

7. Revalidation of GDPs registration with the emphasis on core topics including IE prophylaxis and medical problems in dentistry.

REFERENCES

Al-haroni, M. and Skaug, N. (2006), Knowledge of prescribing antimicrobials among Yemeni general dentists**. Acta Odontologica Scandinavica**, 64(5):274-280.

Azariah, E. Veerabahu, M. and Raman, U. (2007), Awareness of prophylaxis against infective endocarditis among general dental practitioners, a knowledge attitude and practice study. **International Journal of Oral & Maxillofacial Surgery**, 36(11): 1032-1033.

Baddour, LM. Wilson, WR. and Bayer, AS.(2005), Infective endocarditis: diagnosis, antimicrobial therapy, and management of complications: a statement for healthcare professionals from the Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease, Council on Cardiovascular Disease in the Young, and the Councils on Clinical Cardiology, Stroke, and Cardiovascular Surgery and Anesthesia, American Heart Association. **Circulation**, 111(23):394-434.

Black, N. Brazier, J. Fitzpatrick, R. Reeves, B. (1998), Designing and using patient and staff questionnaires. In: Black, N. Brazier, J. Fitzpatrick, R. Reeves, B. (eds), **Health Services Research Methods—a guide to best practice**. (pp 115-134), London: BMJ Books.

Bowling, A. (1995), What things are important in people's lives? A survey of the public's judgements to inform scales of health related quality of life. **Social Science and Medicine**, 41(10):1447-1462.

Boyle, N. Gallagher, C. and Sleeman, D.(2006), Antibiotic prophylaxis for bacterial endocarditis--a study of knowledge and application of guidelines among dentists and cardiologists. **Journal of Irish Dental Association**, 51(5):232-237.

Buckingham, JK. Gould, IM. Tervitt, G. and Williams, S .(1992), Prevention of endocarditis: communication between doctors and dentists. **British Dental Journal**, 172(11):414-415.

Carmona, I. Dios, P. and Scully, C. (2007), Efficacy of Antibiotic Prophylactic Regimens for the Prevention of Bacterial Endocarditis of Oral Origin. **Journal of dental research**, 86(12):1142-1159.

Chopra, T. and Kaatz , G.(2010), Treatment strategies for infective endocarditis. **Expert Opinion on Pharmacotherapy**, 11(3):345-360.

Cobe, HM. (1954), Transitory bacteremia. **Oral Surgery, Oral Medicine and Oral Pathology,** 7(6):609-615.

Committee on Prevention of Rheumatic Fever and Bacterial Endocarditis, American Heart Association (1960), Prevention of rheumatic fever and bacterial endocarditis through control of streptococcal infections. **Circulation**, 21:151-155.

Cooper, C. (1988), **Individual Differences**, (1st ed), London: Arnold.

Coutinho, A.Castro, G. and Maia, L. (2009), Knowledge and practices of dentists in preventing infective endocarditis in children. **Special Care dentistry**, 29(4):175-178.

Cronbach, LJ. (1990), **Essentials of psychological testing,** (5th ed.), New York: Harper Colins.

Dajani, A. Bisno, A. Chung, K. Durack, D. Freed, M. Gerber, M. Karchmer, A. Millard, H. Rahimtoola, S. Shulman, S. Watanakunakorn, C. and Taubert, K. (1990), Prevention of bacterial endocarditis: recommendations by the American Heart Association. **Journal of the American Medical Assosiation**, 264(22): 2919-2922.

Dajani, A. Taubert, K. Wilson, W. Bolger, A. Bayer, A. Ferrieri, P. Gewitz, M. Shulman, S. Nouri, S. Newburger, J. Hutto, C. Pallasch, T. Gage, T. Levison, M. Peter, and G. Zuccaro, G Jr.(1997), Prevention of bacterial endocarditis: recommendations by the American Heart Association. **Journal of the American Medical Assosiation,** 277(22):1794-1801.

Daly, CG. Currie, BJ. Jeyasingham, MS.Moulds, RFW. Smith, JA. Strathmore, NF. Street, AC. and Goss, AN. (2008), A change of heart: the new infective endocarditis prophylaxis guidelines. **Australian Dental Journal**, 53(3): 196-200.

Dar-Odeh, N. Abu-Hammad, O. Al-Omiri, M. Khraisat, A. and Shehabi, A. (2010), Antibiotic prscribing practices by dentists: A review. **Therapeutics and Clinical risk management**, 36(9):1439-49.

Delahaye, F. Harbaoui, B. Cart-Regal, V. and Gevigney, G. (2009), Recommendations on prophylaxis for infective endocarditis: Dramatic changes over the past seven years, French Recommendations. **Archives of Cardiovascular Disease**, 102(3):233-245.

Ellervall, E. Brehmer, B. and Knutsson, K. (2008), How confident are general dental practitioners in their decision to administer antibiotic prophylaxis? A questionnaire study. **BMC Medical Informatics and Decision Making**, 8:57-84.

Embil, J.and Chan, K. (2008), The American Heart Association 2007 Endocarditis Prophylaxis Guidelines, A compromise between science and common sense. **Canadian Journal of Cardiology**, 24(9):673-675.

Epstein, JB. (1999), Infective endocarditis and dentistry: outcome-based research. **Journal of the Canadian Dental Association**, 65(2):95-96.

Epstein, J. Chong, S. and Le, N. (2000), A survey of antibiotic use in Dentistry. **Journal of the American Dental Association**, 131(11):1600-1609.

Eskandari A. Abolfazli N. and Lafzi A. (2008), Endocarditis Prophylaxis in Cardiac Patients: Knowledge among General Dental Practitioners in Tabriz. **Journal of Dental Research, Dental clinics & dental prospects**, 2(1):15-19.

Forner L, Larsen T, Kilian M, Holmstrup P (2006), Incidence of bacteremia after chewing, tooth brushing and scaling in individuals with periodontal inflammation. **Journal of Clinical Periodontology**, 33(6):401-407.

Fowler, V. Scheld, W. and Bayer, A. (2005), Endocarditis and intravascular infections. In: Mandell, G. Bennett, J. and Dolin, R. (Eds), **Principles and Practices of Infectious Diseases,** (pp. 975-1021), U.K., Elsevier Churchill Livingstone.

French Recommendations, (2002), Revision of the March 1992 French consensus conference, Prophylaxis of infective endocarditis. **Medecine et maladies infectieuses**, 2:587-595.

Gould, FK. Elliott, T. Foweraker, J. Fulford, M. Perry, J. Roberts, G. Sandoe, J. and Watkin, R. (2006), Guidelines for the prevention of endocarditis: report of the Working Party of the British Society for Antimicrobial Chemotherapy. **Journal of Antimicrobial Chemotherapy,** 57(6):1035-1042.

Hall, G. Hedstrom, SA. Heimdahl, A. and Nord, CE. (1993), Prophylactic administration of penicillins for endocarditis does not reduce the incidence of postextraction bacteremia. **Clinial Infectious Diseases**, 17(2):188-194.

Hall, G. Heimdahl, A. and Nord, CE. (1995), Effects of prophylactic administration of cefaclor on transient bacteremia after dental extraction. **European Journal of Clinical Microbiology Infectious Diseases,** 15(8):646-649.

Horstkotte, D. Follath, F. Gutschik, E. Lengyel, M. Oto, A. Pavie, A. Soler, J. Thiene, G. and von Graevenitz, A. (2004), Guidelines on Prevention, Diagnosis and Treatment of Infective Endocarditis Executive Summary, The Task Force on Infective Endocarditis of the European Society of Cardiology. **Eurorpean Heart Journal**, 25(3): 267-276.

Jaunay, T. Sambrook, P. and Goss, A. (2000), Antibiotic prescribing practices by South Australian general dental practitioners. **Australian Dental Journal,** 45(3):179-186.

Jones, T. Baumgartner, L. Bellows, M. Breese, B. Kuttner, A. McCarty, M. Rammelkamp ,C. (1955), Prevention of rheumatic fever and bacterial endocarditis through control of streptococcal infections, Committee on Prevention of Rheumatic Fever and Bacterial Endocarditis, American Heart Association. **Circulation**, 11:317-320.

Kaner, E. Haighton, C. Mcavoy, B. (1998), 'So much post, so busy with practice so, no time!' A telephone survey of general practitioners' reasons for not participating in postal questionnaire surveys. **British Journal of General Practice**, 48(428):1067-1069.

Kaplan, E. Anthony, B. Bisno, A. Durack, D. Houser, H. Millard, H. Sanford, J. Shulman, S. Stollerman, M. Taranta, A. Wenger, N. (1977), Prevention of bacterial endocarditis, Committee on Rheumatic Fever and Bacterial Endocarditis, American Heart Association. **Circulation**, 56:139-143.

Kline, P. (2000), **The handbook of psychological testing**, (2nd ed), London: Routledge.

Lauber C., Lalh SS., Grace M., Smith MH. MacDougall K., West P. & Compton S. (2007), Antibiotic Prophylaxis Practices in Dentistry: A Survey of Dentists and Physicians. **Journal of Canadian Dental Assossiation**, 73(3):245.

Leport, C. Horstkotte, D. Burckhardt, D. and Group of Experts of the International Society for Chemotheraphy (1995), Antibiotic prophylaxis for infective endocarditis from an international group of experts towards a European consensus. **European Heart Journal**, 16:126-131.

Lockhart, P. (1996), An analysis of bacteremias during dental extractions. A double-blind, placebo-controlled study of chlorhexidine. **Archives of Internal Medicine**, 156(5):513-520.

Lockhart, PB. And Durack, DT. (1999), Oral microflora as a cause of endocarditis and other distant site infections. **Infectious Diseases Clinics of North America**, 13(4): 833-850.

Lockhart, PB. (2000), The risk for endocarditis in dental practice. **Periodontology 2000**, 23:127-135.

Lockhart, PB. Brennan, MT. Kent, ML. Norton, HJ. And Weinrib, DA. (2004), Impact of amoxicillin prophylaxis on the incidence, nature, and duration of bacteremia in children after intubation and dental procedures. **Circulation**, 109(23):2878-2884.

McCrae, RR. and Costa, PT. Jr. (1983), Joint factors in self-reports and rating: Neuroticism, extraversion, and openness to experience. **Personlaity and Individual Differences**; 4: 245-255.

McCrae, RR. and Costa, PT. Jr (1983), Social Desirability scales: More substance than style. **Journal of Consulting and Clinical Psychology**; 51: 882-888.

Murdoch, D. and Corey, G. Hoen, B. (2009), Clinical presentation, etiology, and outcome of infective endocarditis in the 21st century: the International Collaboration on Endocarditis-Prospective Cohort Study. **Archives of Internal Medicine**, 169(5):463-473.

Nakano, K. and Ooshima, T. (2010), Common knowledge regarding prevention of infective Endocarditis among general dentists in Japan. **Journal of Cardiology**, 57(1):123-130.

NICE clinical guideline 64 (2008), **Prophylaxis against infective endocarditis: antimicrobial prophylaxis against infective endocarditis in adults and children undergoing interventional procedures**.

Pallasch, TJ.and Slots, J. (1996), Antibiotic prophylaxis and the medically compromised patient. **Periodontology 2000**, 10:107-138.

Palmer, N. Martin, M. Pealing, R. and Ireland R. (2000), an analysis of antibiotic prescriptions from general dental practitioners in England**. Journal of antimicrobial chemotherapy**, 46(6):1033-1035.

Panos, G. Giamarellou, H. Papazachos, G. Birbilis, T. and Toutouzas, P. (1996), Greek physicians' and dentists' compliance with the British society for antimicrobial chemotherapy (BSAC) guidelines for preventing bacterial endocarditis. **Journal of Chemotherapy**, 8(4):270-277.

Paster, B. Boches, S. Galvin, J. Ericson, R. Lau, C. Levanos, V. Sahasrabudhe, A. and Dewhirst, F.(2001), Bacterial diversity in human subgingival plaque. **Journal of Bacteriology**, 183(12):3770-3783.

Rammelkamp, C Jr. Breese,B. Griffeath, H. Houser, H. Kaplan, M. Kuttner, A. McCarty, M. Stollerman, G. and Wannamaker, L.(1957) Prevention of rheumatic fever and bacterial endocarditis through control of streptococcal infections, Committee on Prevention of Rheumatic Fever and Bacterial Endocarditis, American Heart Association. **Circulation**, 15:154-158.

Ramsdale, D. Elliott, T. Wright,P. Roberts, G.Wallace, P. Fabri, B. Palmer, N. Nihoyannopoulos, P. Pearson, M.Mutton, C. Broadbent, D. (2004),**Dental Aspects Of Endocarditis prophylaxis: New recommendations from the British Cardiac Society Guidelines and Medical Practice Committee and Royal College of Physicians Clinical Effectiveness and Evaluation Unit**, 85(2):133-142.

Rheumatic Fever Committee and the Committee on Congenital Cardiac Defects, American Heart Association (1972), Prevention of bacterial endocarditis. **Circulation**, 46:3-6.

Roberts, G. (1999), Dentists are innocent! “Everyday” bacteremia is the real culprit: a review and assessment of the evidence that dental surgical procedures are a principal cause of bacterial endocarditis in children. **Pediatric Cardiology**, 20(5):317-325.

Roberts, GJ. Holzel, HS. Sury, MR. Simmons, NA. Gardner, P. and Longhurst, P. (1997), Dental bacteremia in children. **Pediatric Cardiology**, 18(1):24-7.

Salakoa, N. Rotimib, V. Adibb, SM. and Al-Mutawac, S. (2004), Pattern of antibiotic prescription in the management of oral diseases among dentists in Kuwait. **Journal of Dentistry**, 32(7):503-509.

Sconyers, JR. Crawford, JJ. and Moriarty, JD.(1973), Relationship of bacteremia to toothbrushing in patients with periodontitis. **Journal of American Dental Assosiation,** 87(3):616-622.

Shanson, DC. Akash, S. Harris, M. and Tadayon, M. (1985), Erythromycin stearate, 1.5 g, for the oral prophylaxis of streptococcal bacteraemia in patients undergoing dental extraction: efficacy and tolerance. **Journal of Antimicrobial Chemotherapy**, 15(1):83-90.

Shulman, S. Amren, D. Bisno, A. Dajani, A. Durack, D. Gerber, M. Kaplan, E. Millard, H. Sanders, W. Schwartz, R. and Watanakunakorn, C. (1984), Prevention of bacterial endocarditis: a statement for health professionals by the Committee on Rheumatic Fever and Infective Endocarditis of the Council on Cardiovascular Disease in the Young, Committee on Rheumatic Fever and Infective Endocarditis, American Heart Association. **Circulation**, 70:1123-1127.

Soheilipour, S. Dunne, SM. Newton, JT. and Jabbarifar, SE. (2010), Implementation of clinical practice guidelines in dental settings. **Journal of Evidence-Based Dental Practice,** 9(4):183-193.

Wannamaker, L. Denny, F. Diehl, A. Jawetz, E. Kirby, W. Markowitz, M. McCarty, M. Mortimer, E. Paterson, P. Perry, W. Rammelkamp, C Jr. and Stollerman, G.(1965), Prevention of bacterial endocarditis, Committee on Prevention of Rheumatic Fever and Bacterial Endocarditis, American Heart Association). **Circulation**, 31:953-954.

Wilson, G. Taubert, A. Gewitz ,M. Lockhart, P. Baddour, L. Levison, M. Bolger, A. Cabell, C. Takahashi, M. Baltimore, R. Newburger, J. Strom, B. Tani, L. Gerber, M. Bonow, R. Pallasch, T. Shulman, S. Rowley, A. Burns, J. Ferrieri, P. Gardner, T. Goff, D. and Durack, D.(2007), Prevention of Infective Endocarditis Guidelines From the American Heart Association. **Circulation**, 116:1736-1754.

Zadik, Y. Findler, F. Livne, S. Levin, L. and Elad, S. (2008), Dentists' knowledge and implementation of the 2007 American Heart Association guidelines for prevention of infective endocarditis. **Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiolology & Endodontics**, 106(6):16-9.

Zare,i MR. Navabie, N. and Chamani, G. (2008), Assessment Of Awareness Of Recommendations for prevention of bacterial endocarditis among a roup of 136 iranian dental & medical students. **Acta Medica Iranica**, 46(1):51-58.

APPENDIX 1

THE CONSENT FORM

الجامعة الاردنية

كلية طب الاسنان

تهدف هذه الاستبانه الى جمع معلومات عن الاتجاهات المتبعه للوقايه من التهاب شغاف القلب بين اطباء الاسنان في الاردن.
نود التاكيد ان جميع المعلومات سيتم التعامل معها بسريه.

اوافق على المشاركه في هذا الاستبيان.

التوقيع:-----------------

APPENDIX 2
THE QUESTIONNAIRE

Part 1: Personal Information

1.	Age: ( )

2.	Gender: ( )

3.	Year of graduation:	
	Undergraduate	( )
	Post-graduate (if present)	( )

4.	Place of graduation:	
	Undergraduate	( )
	Post-graduate (if present)	( )

5.	Type of dental specialty (If present):

6.	Present work : (choose from the choices below)
	Private practice
	Royal Medical services
	University
	Ministry of Health

7.	Town: ( )

8.	Previous/current Academic job involvement	
	Yes	No

Part 2: Antibiotic prophylaxis practices
A: cardiac conditions.

Do you prescribe prophylactic antibiotics before invasive dental treatment in a patient who suffers the following cardiac condition?

1.Prosthetic cardiac valves	○ Yes	○ No	○ I don't know
2.Mitral valve prolapse With valvular regurgitation	○ Yes	○ No	○ I Don't know
3.Previous Infective Endocarditis illness	○ Yes	○ No	○ I Don't know
4.Previous coronary artery bypass graft surgery	○ Yes	○ No	○ I Don't know
5.Hypertrophic cardiomyopathy	○ Yes	○ No	○ I Don't know
6.Intravascular cardiac pacemakers	○ Yes	○ No	○ I Don't know
7.Myocardial infarct in the last 6 months	○ Yes	○ No	○ I Don't know
8.Cardiac transplantation recipients who develop cardiac valvulopathy	○ Yes	○ No	○ I Don't know
9.Unrepaired cyanotic heart disease (CHD)	○ Yes	○ No	○ I Don't know
10.Recently placed Coronary stents	○ Yes	○ No	○ I Don't know
11.Atrial septal defect after 6 months of repair	○ Yes	○ No	○ I Don't know
12.Ventricular septal defect with repair	○ Yes	○ No	○ I Don't know
13.Patent foramen ovale in kids or adults	○ Yes	○ No	○ I Don't know
14.Patent ductus arteriosus	○ Yes	○ No	○ I Don't know
15.Pregnancy with mitral valve regurgitation	○ Yes	○ No	○ I Don't know
16.Cardiac catheterization without stents/less than 1 year	○ Yes	○ No	○ I Don't know
17.Pulmonary Hypertension	○ Yes	○ No	○ I Don't know

B: Dental procedures:

Do you prescribe prophylactic antibiotics before the following dental procedures in an endocarditis high-risk patient?

Procedure	Yes	No	I don't know
1.Dental examination	○ Yes	○ No	○ I don't know
2.Intraoral radiographs	○ Yes	○ No	○I don't know
3.Shedding of primary teeth	○ Yes	○ No	○ I don't know
4.Brushing and flossing	○ Yes	○ No	○ I don't know
5.Fluoride treatment	○ Yes	○ No	○ I don't know
6.Local anesthetic infiltration	○ Yes	○ No	○ I don't know
7.Intrligamentary anesthesia	○ Yes	○ No	○ I don't know
8.ID block	○ Yes	○ No	○ I don't know
9.Placement of rubber dam	○ Yes	○ No	○ I don't know
10.Gingival retraction cord	○ Yes	○ No	○ I don't know
11.Tooth preparation& impression taking	○ Yes	○ No	○ I don't know
12.Matrix band and wedging	○ Yes	○ No	○ I don't know
13.Endodontic treatment	○ Yes	○ No	○ I don't know
14.Scaling	○ Yes	○ No	○ I don't know
15.Root planning	○ Yes	○ No	○ I don't know
16.Periodontal surgery	○ Yes	○ No	○I don't know
17.Crown lengthening	○ Yes	○ No	○ I don't know
18.Biopsy	○ Yes	○ No	○ I don't know
19.suture removal	○ Yes	○ No	○ I don't know
20.Tooth extraction	○ Yes	○No	○I don't know
21.Dental implants	○ Yes	○ No	○ I don't know
22.Apicectomy	○ Yes	○ No	○ I don't know
23.Surgical abcess drainage	○ Yes	○ No	○ I don't know
24.Surgical removal of 3rd molar	○ Yes	○ No	○ I don't know
25.Maxillofacial surgery	○ Yes	○ No	○ I don't know
26.Placement of orthodontic appliance	○ Yes	○ No	○ I don't know
27.Dento-Alveolar trauma	○ Yes	○ No	○ I don't know
28.Bleeding from trauma to lips and oral mucosa	○ Yes	○ No	○ I don't know
29.Replantation of avulsed teeth	○ Yes	○ No	○ I don't know
30.Oro-antral communication	○ Yes	○ No	○ I don't know
31.Oral ulcers	○ Yes	○ No	○ I don't know

C: General considerations:

1. Is your decision of prescribing antibiotic prophylaxis for infective endocarditis affected by the following factors?

	Yes	No
o Age	Yes	No
o Patient's wishes	Yes	No
o Strong family history of heart disease	Yes	No
o Cost of antibiotic	Yes	No

2. Do you think there is a relationship between infective endocarditis and the following?

	Yes	No
o Poor oral hygiene	Yes	No
o Dental/periodontal disease	Yes	No

3. Do you refer your cardiac patients to their physician before undergoing invasive dental procedures?
   - All the time
   - Not necessarily
   - Not at all

4. If yes, do you require a written document from the cardiologist?
   - Yes
   - No

Part 3: Infective Endocarditis Guidelines

---

1. On what basis do you prescribe antibiotic prophylaxis for patients undergoing invasive dental procedures? (you can choose more than one answer)
   - o personal experience
   - o previous academic knowledge
   - o Professional medical bodies
   - o colleagues recommendations

2. Which guidelines do you follow for prescribing Infective Endocarditis prophylaxis regimens for your susceptible patients?
   (you can choose more than one answer)
   - o European Society of Cardiology (ESC)
   - o British Cardiac Society (BCS)/Royal College of Physicians (RCP)
   - o British Society for Antimicrobial Chemotherapy (BSAC)
   - o American Heart Association (AHA)
   - o National Institute for Health and Clinical Excellence (NICE)
   - o None

Part 4: Antibiotic prophylaxis regimen

Please choose the answer that describes your antibiotic prophylaxis regimen practices for non-penicillin allergic cardiac patient for questions 1 to 4 :

1.antimicrobial agent:

- Yes, I give (write the name of the drug please)________________
- No, I do not give
- I do not know

2.Route of administration:

- Oral
- Venous
- Intramuscular
- I do not know
- I do not give

3.pre-operative dosage:

- Yes, I give (write the <u>dose</u> & the <u>timing</u> please)_____________________
- No, I do not give
- I do not know

4.post-operative dosage

- Yes, I give (write the <u>dose</u> and the <u>timing</u> please)_____________________
- No, I do not give
- I do not know

معرفة وممارسات الوقاية من التهاب شغاف القلب الخمجي بين أطباء الأسنان الأردنيين

إعداد

نور كايد الفرح

المشرف

الدكتور محمود العميري

المشرف المساعد

الأستاذ الدكتوره لميس د. رجب

ملخـــــص

هذه دراسة عرضية تهدف إلى تقييم معرفة وممارسات أطباء الأسنان الأردنيين المتعلقة بالوقاية من التهاب شغاف القلب الخمجي باستخدام المضادات الحيوية.

استخدمت الدراسة استبيان مكوّن من أربعة أجزاء، وزعت بشكل عشوائي على 300 طبيب أسنان ممارس في الأردن. أسئلة الاستبيان غطت: البيانات الديموغرافيه، أمراض القلب والإجراءات السنّية التي تتطلب الوقاية من التهاب شغاف القلب بواسطة المضادات الحيوية، طرق تحديث معلومات الوقاية من التهاب شغاف القلب وبروتوكول استخدام المضادات الحيوية المتبع للوقاية.

وجد أن متوسط درجات الإجابات الصحيحة (من 100) لأمراض القلب والإجراءات السنّية التي تتطلب الوقاية هي: 72,1 و 57,1 على التوالي. معظم المشتركين بالدراسة يستخدمون الأموكسيسلين (74%)، يقومون بتحويل مرضى القلب إلى الطبيب المعالج (79,9%) ودراستهم الأكاديمية السابقة كانت المصدر الرئيسي للمعلومات. أكثر من نصف المشتركين بالدراسة يتبعون تعليمات الجمعية الأمريكية للقلب وارتخاء صمام القلب الميترالي ووضع السد المطاطي حصلوا على أقل عدد من إجابات المشتركين الصحيحة.

معرفة أطباء الأسنان العامة في هذه الدراسة لم تكن كافية، ووجد نمط من الإفراط في صرف المضادات الحيوية للوقاية من التهاب شغاف القلب الخمجي.نوصي بمراجعة مناهج طب الأسنان في الجامعات الأردنية حتى يتم تغطية موضوع الوقاية من التهاب شغاف القلب بشكل شامل، والمزيد من الوسائل والبرامج التعليمية لتحديث معلومات أطباء الأسنان في الأردن المتعلقة بالوقاية من التهاب شغاف القلب الخمجي باستخدام المضادات الحيوية.